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Roentgen Therapy of Wilms' Tumor[1]

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WILMS' TUMOR, adenomyosarcoma, or embryonal mixed tumor of the kidney, is the most common renal neoplasm occurring in infancy and childhood. Some examples, however, have been reported in adults. The prognosis in a majority of cases is generally unfavorable, and the course of the disease is usually rapid.

SYMPTOMATOLOGY

The familiar triad of symptoms for renal neoplasms—hematuria, pain, and a mass—is not found in all cases of Wilms' tumor. The usual finding in these cases is a rapidly growing mass. In 2 of the cases to be reported here, hematuria was the initial symptom pointing toward a disturbance in the urinary tract. Persistent pain was not reported in any of the cases; but in 2, vague abdominal pain associated with gastric disturbances was noted over a period of several months. These vague abdominal pains were generally associated with meals. The blood pressure was not elevated in any of the cases to be presented. Hypertension may occur, however, in some instances, as observed by Bradley and Pincoffs in their series of cases (1). Trauma may be associated with the onset of the more severe symptoms, as occurred in Case III, reported below.

PHYSICAL FINDINGS

The patient is usually a child averaging three to five years of age, fairly well nourished and in apparent good health. A mass in either flank, of varying size, smooth contour, and firm consistency, that moves on deep inspiration, is found. As metastases from Wilms' tumor are generally blood-borne, care should be taken in examining these patients not to palpate the tumor more than is absolutely necessary.

DIAGNOSIS

Other abdominal tumors that may be encountered in children and lead to some confusion in differential diagnosis are medulloblastoma of the adrenals, retroperitoneal sarcoma, lymphosarcoma of the bowel, congenital abnormalities of the kidney, mesenteric and pancreatic cysts, and splenomegalia associated with leukemia or lymphoblastoma.

Complete radiographic and urologic examination of the urinary tract in these patients is definitely indicated. As they are generally young, a cystoscopy with retrograde pyelography is not always feasible. There are also cases in which the intravenous route for visualization of the renal pelves and calices is not technically possible. In these cases, differential diagnosis of Wilms' tumor may be carried out by intramuscular urography, using a 35 per

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cent solution of diodrast intragluteally, as described by Adams and Hunt (2).

Even though we are generally desirous of knowing the histology of the tumor with which we are dealing, biopsy either by the aspiration method or exposure of the tumor is to be condemned because of the danger of spreading this anaplastic growth. Reliability of diagnosis should be dependent upon the clinical history, physical examination, and roentgenographic study.

Preliminary roentgenographic examination of the urinary tract will reveal a tumor of varying size, overlying one or the other kidney area. Following the intravenous administration of the dye, one will note several changes on the affected side: (1) delay in appearance of the dye; (2) distortion of the kidney pelvis and calices, by the tumor; (3) medial displacement of the ureter, when this is demonstrated; (4) variable displacement of the kidney pelvis and calices, depending upon the location of the tumor within the kidney and its size.

PATHOLOGY

Considerable argument as to the true origin of Wilms' tumor has occurred. Dean and Pack (3) found that the following theories have been put forth: origin from aberrant germ plasm; origin from the wolffian body; origin from the renal blastema or nephrotome; origin from the endothelium. In their review they came to the following conclusions as to the origin of this tumor: (*a*) that the tumor originates at different developmental periods of the embryo; (*b*) that the renal blastema or nephrotome is a predominating contributing structure, and a tumor anlage which establishes itself at this stage will elaborate tissue easily recognized as renal in origin; (*c*) that in a tumor anlage which separates earlier, before the formation of the nephrotome, there is a larger number of possibilities for elaborating multiple tumor cells, which may account for the presence of muscle fibers and other tissues in the tumor.

Macroscopically, Wilms' tumor is found anywhere within the renal capsule and may occupy any position within the kidney substance. The tumors may be solid or may have reached such size as to be cystic and necrotic, with large areas of hemorrhagic necrosis. The mass of the tumor is usually quite well demarcated and is surrounded by a fibrous capsule that somewhat infiltrates into the renal substance. The surrounding kidney tissue will show thinning and destruction, due to pressure of the tumor. The central portion of the neoplasm is often gelatinous in character, with irregular strands of fibrous tissue running through it, interlacing with glandular, muscular, or cellular tissue, depending upon the predominating element present. Wilms' tumors vary greatly in size and shape. They may be firm, smooth, lobulated, or cystic. The most common sites of metastases are the liver, lungs, and bones. An extension of the tumor through the vena cava to the heart has been reported (4).

Microscopically, the predominating feature of Wilms' tumor is its embryonal nature. Many types of undifferentiated cellular structure are shown and these vary greatly in different tumors. Smooth or striated muscle cells are generally seen in some portion of the tumor, although none was noted in any of the following cases. Occasionally muscular tissue constitutes a large part of the growth. Glandular areas made up of columnar or cuboidal epithelium and surrounded by areas of spindle cells may compose the bulk of the tumor. Either glandular tissue or connective tissue may be in excess. Islands of cartilage and bone have been observed (4).

TREATMENT

Various methods of treatment for Wilms' tumor have been advocated: (*a*) nephrectomy alone; (*b*) radiation therapy alone; (*c*) nephrectomy with postoperative radiation therapy; (*d*) nephrectomy with preoperative radiation therapy; (*e*) nephrectomy with preoperative and postoperative radiation therapy.

In a survey of 383 cases, by McNeill and Chilko (5), the mortality was found to be

well over 90 per cent. As to the type of treatment to be used in these cases, many differences of opinion still exist. Ladd and White (6 and 7), in a review of 60 cases, stress the importance of immediate surgery as soon as the diagnosis of a kidney tumor is established. Of their 60 cases, 14 were probably cured (operation had been performed too recently to determine the status of 4 cases). They believe that metastasis, if it does occur, will generally take place within two years. It is their conclusion that during the time required for administration of preoperative radiation and the waiting period for surgery, the chance of metastasis by way of the blood stream is very good. They also contend that shrinkage of the tumor is apt to force malignant cells into the blood stream. It is their opinion that, with proper preparation of the patient and with the transperitoneal approach, the operative mortality is negligible and the chance of malignant cells being forced into the blood stream is much less. They have treated some of their cases with postoperative roentgen therapy but as yet have insufficient data to permit evaluation of their results. Their records show that the size of the tumor had no relation to the ultimate outcome and there was no correlation of the tumor size with any predominant cell type or possibility of permanent cure.

In a series of 17 cases reported by Kretschmer and Hibbs (8), in which no preoperative roentgen therapy was administered, only one patient was living and well nine years after nephrectomy, the remaining 16 having died within six months following surgery.

Kretschmer (9 and 10) in a report of 10 cases, 8 of which had preoperative roentgen therapy, shows a survival of three years and four months for one child and two years and six months for another, following operation. Two of the 8 children that received preoperative roentgen therapy died before surgery could be undertaken, having sought medical attention too late. The 2 that did not receive preoperative roentgen therapy also died shortly following operation. Basing his opinion upon these results, Kretschmer feels that the maximum benefit from preoperative roentgen therapy was noted in four to six weeks after its administration. It is his opinion that this is the ideal time for a nephrectomy and that postoperative irradiation should follow.

Soloway (11), in a review of 130 cases of renal tumor, of which 8 were Wilms' tumors, states that preoperative and postoperative deep x-ray therapy should be employed in all cases.

Priestley and Broders (12), in a review of 65 cases of Wilms' tumor, conclude that preoperative irradiation followed in three to six weeks by nephrectomy, with extensive postoperative irradiation, constitutes the method of choice in these patients.

Of the 4 cases to be reported here, one was treated by immediate nephrectomy with postoperative roentgen therapy; the other 3 received preoperative irradiation followed by transperitoneal nephrectomy and postoperative roentgen therapy. The patient who was not irradiated preoperatively died within four months following surgery, while the 3 who received preoperative and postoperative roentgen therapy combined with nephrectomy have all survived thus far. The survival periods following surgery in the 3 cases are four years and nine months, one year and ten months, seven months. Recent examination of the last 2 patients shows no demonstrable signs of recurrence. It is somewhat early to determine what the ultimate outcome will be in these two cases. We believe, however, that the prognosis is probably good, since metastasis usually occurs early following surgery in patients with this type of tumor.

Preoperative roentgen therapy, in our opinion, should be used for the following reasons: (1) It reduces the size of the tumor and thus facilitates the operation, in the hands of most surgeons, so that there is a minimum amount of handling of the tumor, thereby keeping any malignant cells from being forced into the blood stream. (2) A certain amount of fibrosis is produced, which leads to a closing off of

Fig. 1. Case I: Right renal tumor with distortion of pelvis and calices.

a number of blood vessels, so that the tumor cells cannot be forced into the blood stream by handling. (3) It allows time for good physical preparation of the patient and assures better physical condition at the time of surgery. (4) It serves as a diagnostic aid, as these tumors are generally very radiosensitive.

Close co-operation between the radiologist and the urologist should be the watchword in these cases, so that the ideal time for surgery can be elected following the preoperative roentgen therapy. We believe that nephrectomy should follow irradiation in four to six weeks. A longer interval was allowed in one of the following cases, because of the poor physical condition of the patient and the slow regression of the tumor. There was also, in this case, a question of a pulmonary metastasis, which later proved to be a small area of infiltration due to an acute upper respiratory infection. Postoperative roentgen therapy we believe, should be given within three to six weeks following surgery, or as soon as the condition of the patient will permit. Preoperative irradiation, in our opinion, based upon a review of the literature and upon our experience in this small series of cases, is much more important than postoperative.

TECHNIC

In this series a total of 3,500 to 4,000 r, measured with back-scatter, was administered to the tumor area through four or six ports, using 200,000 volts constant potential, Thoraeus A filtration, 50 cm. distance, 18 ma., H.V.L. 2.250 Cu.

CASE REPORTS

CASE I: L. H. (Ref. by A. D. M.): A white male, age 5, was admitted to the hospital Feb. 12, 1936, having first passed blood in the urine on Dec. 16, 1935. At that time he had a severe upper respiratory infection. Ten days later there was a recurrence of bleeding, which continued intermittently until admission. One week before hospitalization, a physician made a diagnosis of nephritis. On a second visit to the physician a tumor was discovered in the left flank and the child was referred to a urologist for consultation.

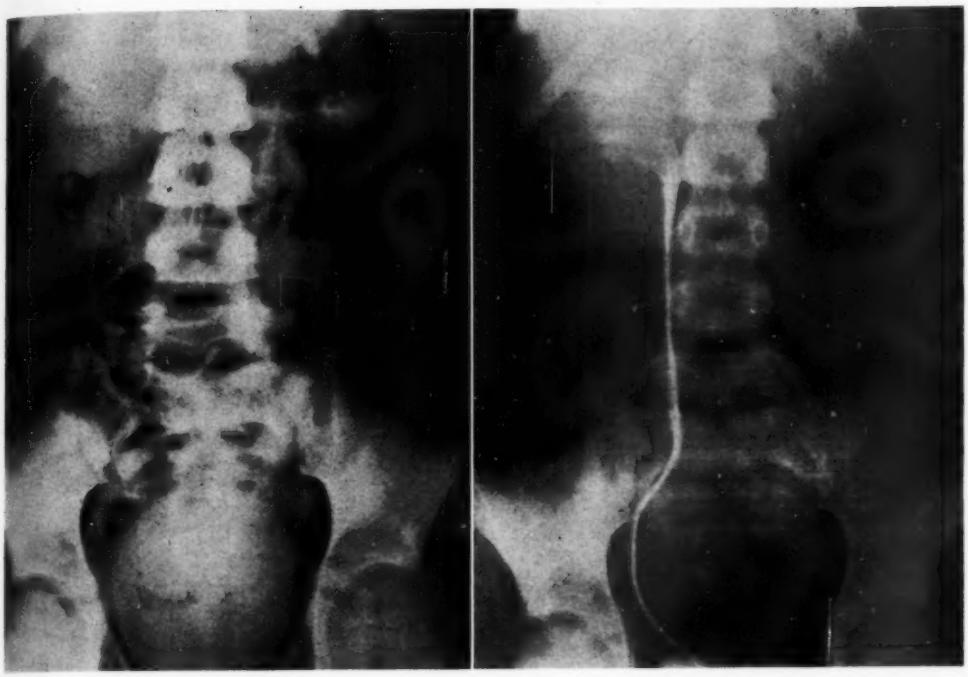
Physical Examination: There was a palpable hard mass in the right flank. Otherwise, the physical findings were not significant. Blood pressure, systolic 72; diastolic 50.

Laboratory Examination: Urinalysis, Feb. 12: acid, specific gravity 1.020, trace of albumin, sugar 0, acetone 0, diacetic 0, leukocytes 1 +, erythrocytes 3+. The red cell count was 4,070,000, hemoglobin 78 per cent, white cell count 8,900.

X-Ray Examination (Feb. 12, 1936): Intravenous urography showed distortion of the lower calices on the right with displacement of the kidney pelvis upward. A mass measuring 8 cm. in diameter was seen arising in the lower pole of the right kidney. Normal function and kidney outline were noted on the left (Fig. 1).

Treatment: Transperitoneal right nephrectomy was done on Feb. 13, the kidney pedicle being isolated, ligated, and amputated before manipulating the kidney. Postoperative roentgen therapy was given from March 17 to April 1, 1936, a total of 3,980 r, measured with back-scatter, being administered through two anterior and two posterior ports 10 cm. square, on the right. The factors were 200 kv. constant potential, 18 ma., Thoraeus C filter, 50 cm. distance, H.V.L. 3.50 Cu, 0.070 Å. effective wave length.

Progress: The patient made an uneventful recovery from operation and roentgen therapy.



Figs. 2 and 3. Case II: Right renal tumor with delayed function and distortion of pelvis and calices.

On Feb. 20 the surgeon made the following note: "On arms, trunk and legs are discrete hard nodules about the size of small grains of wheat. Mother states some of these have been in evidence for over a year, while others have made their appearance more recently. Must consider possibility of metastasis."

Roentgenographic examination of the chest, May 29, 1936, showed extensive infiltration of both lung fields, consistent with metastatic neoplasia.

Death occurred in July 1936.

Gross Pathology: The kidney measured 12 × 8 × 5 cm. There was a definite generalized enlargement of the lower pole. On palpation this region was soft and several small, rounded, somewhat yellowish discolored elevations were seen beneath the capsule, which was intact. The renal pelvis and the upper ureter were filled with clotted blood.

Cut section revealed a soft bulging tumor, 8 cm. in diameter, in the lower pole of the kidney. Fibrous connective-tissue strands were seen running through the surface of the tumor, and it was surrounded by what appeared to be a very distinct fibrous connective-tissue capsule. The lower half showed hemorrhagic degeneration which in some spots was almost gelatinous. There were also some distinct yellow irregular areas present. The kidney cortex surrounding the tumor was thin and in some areas completely destroyed. The upper pole of the kidney showed little of note; there was considerable displacement of the kidney pelvis and upper calices.

Microscopic Pathology: The dominating feature of the tumor from a microscopic standpoint was the presence of large glandular areas made up of cells chiefly columnar in character and surrounded by rather thinly arranged spindle-like cells. The stroma of the tumor consisted of two types of cells. The predominating type was a collagen-producing cell containing relatively few nuclei. Large areas of necrosis were present. The pathologist was unable to find any definite striated muscle or definitely recognizable smooth muscle in the tumor. In this respect it departs somewhat from the usual microscopic picture. The other findings, however, are typical and perfectly diagnostic of the so-called Wilms' tumor of the kidney which appears in childhood and infancy.

CASE II: T. W. (Ref. by A. D. M.): A white child, age 8, was admitted to hospital Jan. 27, 1938, with a history of gross hematuria on Jan. 23, that had persisted until the time of admission. The patient had been in good health until that time except for a chronic otitis media of the right ear, of five or six years' duration. For the past year, there had been recurrent attacks of severe upper right abdominal pain after meals, attributed to an allergy for wheat.

Physical Examination: There was a mass in the

right kidney area, approximately twice the size of a normal kidney, palpable anteriorly and posteriorly. It moved with respiration, was firm in consistency, and was not tender.

Laboratory Examination: Red blood cells 4,060,000; hemoglobin 56 per cent; white cells 6,400 (polymorphonuclears 50 per cent; lymphocytes 50 per cent). Urinalysis: red, neutral, specific gravity 1.017, albumin 2+, sugar 0, acetone 1+, leukocytes 2+, erythrocytes 4+, no casts. Sedimentation time: 23 mm. in fifty minutes.

X-Ray Examination: The left kidney was normal in size, shape, and position, and urinary dynamics and anatomy were normal in the left upper urinary tract. The right kidney was twice normal size. Dye did not appear in the right kidney until after an interval of thirty minutes and there was no concrete outline of intrarenal structures (Fig. 2). In the region of the upper calix on the right a collection of dye appeared, about 2 cm. in diameter, with an irregular circular outline.

Retrograde pyelography, with cystoscopy, showed smoky urine coming from the right ureteral orifice. There was no difficulty in catheterization of the right ureter. The calices were not well outlined (Fig. 3).

X-ray examination of the chest was negative for metastases.

Treatment: Preoperative roentgen therapy was given from Jan. 30 to Feb. 15, 1938. A total of 4,000 r with back-scatter was administered through two anterior and two posterior ports 10 cm. square. The factors were: 200 kv. constant potential, 18 ma., Thoraeus A filtration, 50 cm. distance, H.V.L. 2.250 Cu, 0.101 Å. effective wave length.

At the time of admission to the hospital, for nephrectomy, the tumor was no longer palpable. A right nephrectomy was done March 8, using the transperitoneal approach, with early ligation of the pedicle followed by excision of the tumor.

Postoperative roentgen therapy was administered from April 11 to April 28, using the above technical factors and giving a total dosage of 3,300 r measured with back-scatter.

On Sept. 15, 1942, the patient remained well and in good health, with no signs of recurrence.

Gross Pathology: The kidney measured 8.5 × 4.5 × 3.0 cm. The lower pole showed thickening and a palpable firm area. On cut section the kidney appeared to be normal with the exception of an area in the lower pole measuring 1.5 cm. in diameter. This had a pale gray margin and a homogeneous yellow center. Projecting from this area into the lower calix and practically filling the lower half of the pelvis of the kidney was a soft, gelatinous mass of tissue about 3 cm. in diameter, which was obviously an extension of the tumor. The mucous membrane of the pelvis showed punctate hemorrhage surrounding the tumor.

Microscopic Pathology: A section of a regional lymph node from the hilar region of the kidney showed no evidence of tumor formation. The tissue extending into the renal pelvis from the tumor showed necrosis and revealed no discernible cell structures. The mass of the tumor itself was composed largely of homogeneous tissue resembling connective tissue. A few remnants of tissue suggesting kidney tubules remained in this area. There were, however, small areas of tumor tissue still present, composed largely of foamy cells having rather dense nuclei. Marked irradiation changes are noted in these cells. Two separate pathological opinions were rendered. One was that this was a Wilms' tumor with changes due to irradiation; the other that it was the remains of a hypernephroma.

CASE III: L. M. (Ref. by Drs. H. B. M. and R R. R.): A white male, age 3, was admitted to the hospital Oct. 17, 1940, having been apparently well until about two weeks previous to admission. During this time he had had intermittent mild abdominal pains. Three days previously he had fallen on his abdomen and complained of severe pain afterward. This was followed by vomiting, continued abdominal pain, loss of appetite, and failure to take fluids, from that time until hospitalization.

The child had been under the observation of a pediatrician since birth (Dr. R. R. R.). He was seen on April 14, 1940, and at that time the abdominal veins were prominent but no masses were discernible. Except for numerous upper respiratory infections in the past the history was not remarkable.

Physical Examination: Examination of the abdomen showed an asymmetrical fullness visible over the left side. There was a palpable, hard, smooth mass in the left abdomen extending to the mid-line medially, to the crest of the ilium inferiorly, and to the costal arch superiorly.

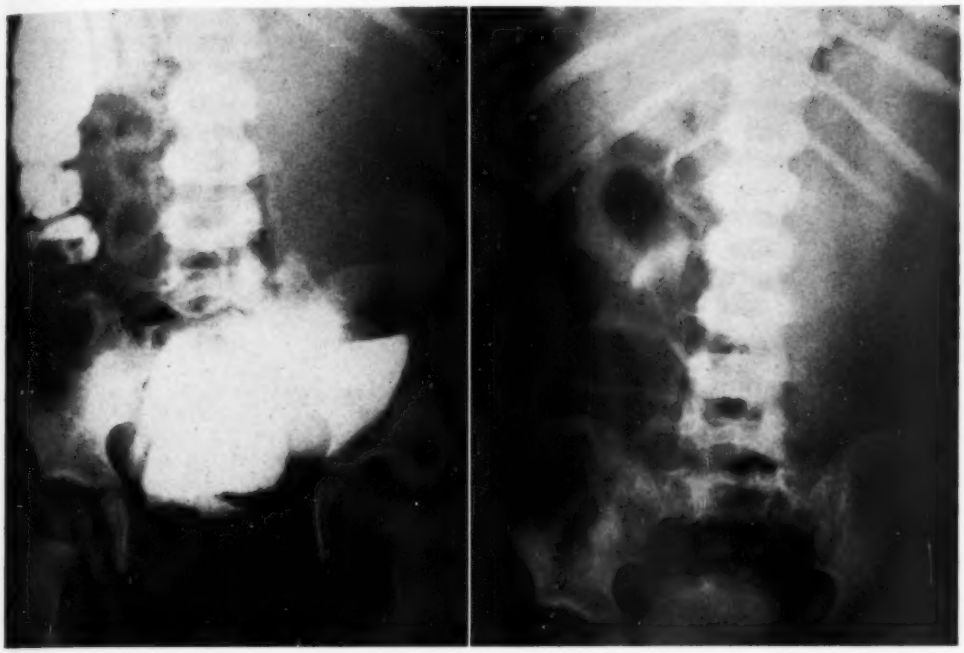
X-Ray Examination (Oct. 17, 1940): A warm barium clysma entered readily and filled the entire colon. The tumor in the left side compressed the descending colon but no lesions were demonstrable in the colonic tract. The descending colon was displaced anteriorly by a retroperitoneal mass (Fig. 4).

Preliminary radiographic examination of the abdomen on Oct. 18 showed the right kidney to be normal in size, shape, and position. On the left side was a large kidney-shaped mass extending from the costal margin downward across the crest of the ilium, homogenous in character and smooth in outline.

With the intravenous administration of diodrast the right kidney was well shown and function appeared good at all times. There was only suggestive evidence of the left kidney about the perimeter of the tumor (Fig. 5).

On Nov. 30, 1940, an area of increased density in the left lower lung field was diagnosed as a possible neoplasm. This had disappeared on Dec. 20.

Intravenous urography on Jan. 3, 1941, showed no changes in the right kidney. The left kidney showed evidence of increased function as compared to previous examination. The mass involving this kidney was one-half its previous size.



Figs. 4 and 5. Case III: Left renal tumor displacing the descending colon. The pyelogram (right) shows only slight renal function on the left.

Laboratory Examination: Successive blood counts were as follows: Oct. 17: red cells 3,210,000, hemoglobin 56 per cent, white cells 24,100. Oct. 24: red cells 4,010,000 hemoglobin 80 per cent, white cells 14,800. Nov. 2: red cells 3,860,000, hemoglobin 76 per cent, white cells 6,800.

Urine examination during the entire period of hospitalization showed nothing remarkable.

Treatment: Treatment during the first period of hospitalization consisted of small frequent transfusions, a total of 500 c.c. of blood being given in a period of four days, and preoperative roentgen therapy.

Roentgen therapy was administered to the left renal area through two anterior, two posterior, and two left lateral ports, 10 cm. square. The factors were: 200 kv. constant potential, 18 ma., Thoraeus A filter, 50 cm. distance, H.V.L. 2.250 Cu, 0.101 Å. A total of 3,500 roentgens measured with back-scatter was administered to the tumor.

During hospitalization, Oct. 17 to Nov. 30, 1940, the temperature varied from 100.5° to 102° daily. Convalescence was slow. During the preoperative interval the patient had an upper respiratory infection and an area of consolidation in the left lower lobe was thought to be a metastasis but later this disappeared. Surgery was deferred because of the child's poor physical condition, until Jan. 10, 1941. Twelve days later, postoperative roentgen therapy was carried out in a similar manner and with the same amount of radiation and the same technical factors as preoperatively.

Operative Report (Jan. 10, 1941): Through a transperitoneal approach, a left nephrectomy was done, the veins being ligated first. The tumor, which was adherent, was carefully dissected out, the artery being clamped later. The tumor extended across the mid-line and was firmly adherent to the aorta and vena cava and was attached by a very short pedicle.

Postoperative convalescence was not remarkable. Transfusions of citrated blood were given, 250 c.c. on two separate occasions.

Gross Pathology: The left kidney was about 50 per cent larger than a normal kidney. It fluctuated and released considerable fluid when opened. A strip of kidney tissue on the inner aspect of the poles was normal. The blood vessels and ureters were normal. A number of lumps of brownish necrotic tissue were present. The tissue was friable and soft on the inside at the pelvic region. Otherwise the interior was largely an empty space from which the fluid had been evacuated.

Microscopic Pathology: Several sections showed only necrosis, with no evidence of malignancy.

Diagnosis: Remains of probable Wilms' tumor, after irradiation.

The child remains well, with no signs of recurrence.

CASE IV: A. D. (Ref. by V. J. R.): A white female, age 8, was admitted to the hospital Feb. 2,

Fig. 6. Case IV: Left renal tumor with deformity of pelvis and calices.

1942, having been seen by her physician the day before admission. Her mother had noticed a mass in the left upper quadrant two or three days previously. She thought that the child had always had a protruding type of abdomen. There had been no apparent loss of weight. There was urinary frequency but no nocturia or gross hematuria. Occasionally in the past the child had complained of abdominal distress, especially after eating, but had had no other complaints.

Physical Examination: There was a hard circumscribed mass, approximately 10 cm. in diameter, in the left upper quadrant, that was movable and descended on deep inspiration.

Laboratory Examination: Urinalysis (Feb. 3, 1942) showed specific gravity 1.030, acid, slight trace of albumin, sugar 0; 10 white blood cells per high power field (centrifuged specimen); occasional red blood cell per high power field. The red blood cell count was 4,510,000; hemoglobin 83 per cent; white cells 5,900.

X-Ray Examination (Feb. 3, 1942): Roentgen examination of the chest revealed no signs of metastases. Preliminary examination of the urinary tract showed a large circumscribed mass on the left side, extending from the median line to the external borders and from just below the iliac crest to the left costal margin. The right kidney was normal in size, contour, and position. Intravenous urography showed normal kidney function on the right. On the left there was marked deformity of the pelvis and the calices were not well demonstrated—characteristic of a new growth involving the left kidney (Fig. 6).

Treatment: Preoperatively a total of 3,900 r with back-scatter was delivered to the left renal area through two anterior, two posterior, and two lateral ports 10 cm. square, over a period of twelve days, Feb. 5 to Feb. 17, 1942. The factors were: 200 kv. constant potential, 50 cm. distance, 18 ma., H.V.L. 2.250 Cu, 0.101 Å., Thoraeus A filter.

On April 1, a left nephrectomy was performed, by the transperitoneal route, with ligation of the left renal vein and artery as soon as exposed. The tumor was well encapsulated, with very few adhesions.

From May 4 to May 14, inclusive, postoperative roentgen therapy was administered, with the above technical factors, giving a total dose of 3,700 r with back-scatter.

Gross Pathology: The left kidney measured 10.5 × 10.5 × 5 cm. The only normal appearing kidney tissue was located at the upper and lower poles. The entire central portion was composed of a mass bulging from the lateral aspect of the kidney and causing enlargement and distention of the organ.

On cut section the tumor was found to be fairly well circumscribed and surrounded by a fibrous capsule. The mass was quite soft in the central portion and had undergone hemorrhagic necrosis. The pelvis and ureter appeared to be entirely normal, with no evidence of invasion.

Microscopic Pathology: Sections of the kidney tumor showed it to be composed almost entirely of necrotic tissue. In recognizable areas of the remaining tumor tissue the appearance was that of a highly undifferentiated malignant nephroma of the Wilms type.

Course of Treatment: Roentgen therapy was started Feb. 5, 1942, preoperatively, with consequent reduction in size of the mass. Considerable toxicity was noted during this series of roentgen therapy, with elevation of temperature due to absorption. The blood reached a level of 53 per cent hemoglobin and 2,740,000 red blood cells. On hospitalization prior to nephrectomy, March 30, 1942, the hemoglobin was 84 per cent and the red blood count 4,690,000.

Convalescence postoperatively was uneventful.

On readmission, May 4, 1942, for postoperative therapy, the hemoglobin was 82 per cent and the red blood count 4,040,000. Radiographic examination of the general skeletal structures showed no evidence of metastasis. The further course was uneventful and the child is in apparently good health, with no signs of recurrence, at the present time.

CONCLUSIONS

1. Four cases of renal tumor in children are presented, one of which was treated by surgery and postoperative irradiation and

the other three by preoperative irradiation, surgery, and postoperative irradiation. The first patient died within five months. The remaining three show, respectively, a survival of four years and nine months, two years, seven months.

2. Combined preoperative irradiation, surgery, and postoperative irradiation offer the most satisfactory method of treatment in these cases, in most hands.

3. Irradiation should be used as an adjunct to surgery, and not as the sole treatment, for this type of tumor.

4. Close co-operation between the radiologist, urologist, and the patient's parents should be the rule, so that the surgery is carried out at the proper time following the administration of the preoperative irradiation. The ideal time for operation is four to six weeks following the preoperative series of irradiation.

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DISCUSSION

Herbert E. Landes, M.D. (Chicago): The kidney is probably the most frequent site of malignant neoplasms of infants and children. About 75 per cent of these tumors occur in children during the first five years of life. Since there are usually no characteristic symptoms until a palpable mass is accidentally discovered, the diagnosis is delayed, often until the tumor is considered to be in an advanced stage.

The warning sign of gross hematuria characteristic of kidney tumors of adults is not, as a rule, present in children, although in the authors' series there were two cases of hematuria. The only symptoms present generally are vague gastro-intestinal disturbances which in no way indicate disease of the kidney. A large, smooth, painless mass in the flank is often the initial sign of a dangerous and rapidly growing neoplasm. At this stage the diagnosis, of course, is not at all difficult. The history, physical findings, and urographic evidence are generally conclusive. While the authors have successfully relied upon excretion urography in 3 of their 4 cases, cystoscopy and retrograde urography will give more clear-cut diagnostic and differential diagnostic data. I would like especially to emphasize that no infant of either sex is too young for this procedure.

As has been stated, the presence of a smooth, firm mass in the flank of an infant or young child suggests the possibility of (1) kidney tumor, (2) adrenal tumor, (3) congenital anomalies of the kidney, including polycystic disease and hydronephrosis, (4) retroperitoneal sarcoma, (5) mesenteric cyst, (6) omental cyst, (7) enlargement of the spleen, (8) enlargement of the liver, and finally, very occasionally, (9) ovarian cyst. Visualization of the urinary tract accurately establishes the relationship of the mass to the kidney and ureter.

There is still some difference of opinion as to the most desirable plan of treatment. The high mortality proves that our present methods are unsatisfactory in the vast majority of cases. These tumors are rapidly growing metastasizing embryonal neoplasms and, as the authors have pointed out, neither the size of the tumor nor the histopathology is prognostic. Most of the tumors are radiosensitive to a high degree—a feature presented by all the authors' cases.

Nephrectomy, in combination with roentgen therapy, has now been generally accepted as offering some hope of permanent cure. The mortality seems to be slightly higher if either method is used alone. Preoperative roentgen therapy is, in my opinion, desirable for the reasons stated by the authors. The small number of cures of several years' duration, regardless of the treatment employed, is still discouraging. These tumors can generally be removed surgically, a transperitoneal approach being preferable. The probability of recurrence is, however, very great.

With the strides that have been made in roentgen therapy during the last few years and a closer cooperation between the roentgenologist and the urologist, we may hope for more satisfactory results in the near future.

Lt. Cmdr. J. Marshall Neely, M.C., U.S.N.R. (U. S. Naval Hospital, Great Lakes, Ill.): While Wilms' tumor is most commonly encountered during childhood, it is occasionally found in adults. The more common adult neoplasm, malignant nephroma of hypernephroma type, is even less commonly seen in children. Histologically Wilms' tumor is usually quite pure as to cell type, but occasionally one finds a case in which it is quite evident that a transition between this type of tumor and the hypernephroma type of malignant nephroma does exist. It seems likely that so-called Wilms' tumor must be considered as a clinical rather than a pathological entity and that the histological pattern considered as characteristic of the tumor in reality represents a point in differentiation in malignant nephromas in general. It is also doubtful if Wilms' tumors are greatly more radiosensitive than hypernephromas except as would be expected in any tumor showing less differentiation.

The objection to preoperative irradiation in this group of tumors is the same as in tumors in general where biopsy information is not available. Surgical pathology following irradiation is always somewhat unreliable, and in those cases where no tumor cells can be found the accuracy of diagnosis must always be questioned.

Since there is no clinical or experimental evidence that biopsy is harmful, I do not believe that we, as radiologists, should use this as an argument for preoperative therapy. In many instances, however, as in some of the cases presented by Doctor Frazer, the diagnosis as evaluated by clinical and roentgen findings is so evident that there should be no hesitation in using preoperative irradiation. Here, simple reduction in tumor size is sufficient indication.

Doctor Frazer is to be congratulated on his excellent presentation.

Urinary Tract Changes with Benign Pelvic Tumors[1]

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ALTHOUGH THE physiological alterations in the urinary tract which occur during pregnancy are well known to radiologists and clinicians, the secondary changes produced by pressure of benign pelvic tumors are not so widely recognized. Many benign pelvic tumors in women are capable of causing changes in the upper urinary tract. The recognition of the frequent occurrence of these alterations is important both to the pelvic surgeon and to the student of the ureter in pregnancy.

In 1935, Baker and Lewis (1) compared the alterations of the urinary tract occurring in pregnancy with those produced by pelvic tumors. Their series included 16 patients with pelvic tumors comparable in size to the pregnant uterus after the third month of gestation. In these patients the quantitative and qualitative alterations in the upper urinary tract were similar to those of pregnancy; a high degree of dilatation was observed in pregnancy, in large ovarian cysts, and in fibromyomas of the uterus. The changes were attributed largely to mechanical pressure.

Kretschmer and Kanter (3) found a high incidence of urinary changes in 51 female patients with benign pelvic tumors. By urography, they showed that 65.7 per cent of myomas and 81.9 per cent of ovarian cysts produced significant alterations in the upper urinary tract. The higher incidence of changes associated with ovarian cysts was explained on the basis of the soft consistency of the tumor and its ability to mold or compress the ureters at the brim of the true pelvis.

Since 1937, we have studied, by excretory urography, 96 adult female patients with benign pelvic tumors of various sizes. Several months after the tumor was removed, another urographic study was done.[2] There were no clinical signs or symptoms of significant urinary tract disease in any of these patients. Thirty cubic centimeters of diodrast[3] were injected intravenously, and a minimum of four radiographic exposures made. These included a roentgenogram of the abdomen, one in the supine position five minutes after the injection, another in the Trendelenburg position at fifteen minutes, and one in the erect posture at twenty minutes.

Of the 96 patients in our series, 66 (68.7 per cent) showed roentgen evidence

TABLE I: EFFECT OF BENIGN PELVIC TUMORS UPON THE UPPER URINARY TRACT

	Myomata	Cysts	Myomata with Cysts	Total Cases
Number	77	14	5	96
Obstruction	39	3	4	46 (47.9%)
Displacement	11	1	0	12 (12.5%)
Both obstruction and displacement	6	2	0	8 (8.4%)
No effect	21 (27%)	8 (57%)	1 (20%)	30 (31.2%)

[1] Presented before the Radiological Society of North America, at the Twenty-eighth Annual Meeting, Chicago, Ill., Nov. 30–Dec. 4, 1942.

[2] The intravenous urograms were made in the Department of Radiology at the Hospital of the University of Pennsylvania, under the direction of Dr. E. P. Pendergrass.

[3] Diodrast for this purpose was supplied through the generosity of the Winthrop Chemical Company.

Fig. 1. Large calcified myoma lying in the anterior portion of the abdomen above the pelvic inlet. There is no ureteral involvement.

TABLE III: EFFECT OF BENIGN PELVIC TUMORS UPON THE UPPER URINARY TRACT: POSITION OF TUMOR

	Freely Movable Tumor	Adherent or Impacted Tumor	Intra-ligamentous Tumor
Obstruction	7	27	12
Displacement	3	4	5
Both obstruction and displacement	0	4	4
No effect	19 (66%)	7 (17%)	4 (16%)
TOTAL	29	42	25

of abnormal effects in the urinary tract is presented in Table II. Fifty of the pelvic tumors were approximately 10 cm. in diameter, and 2 measured as much as 30 cm. Although the size of the tumor was important in producing pressure changes, there was no significant difference in the degree of dilatation produced by tumors greater than 10 cm. in diameter. The total number of the larger tumors is too small, however, to give reliable percentage figures. A huge multilocular cyst which contained 10 liters of fluid was found in one instance arising from the right ovary. This tumor extended high in the abdomen

TABLE II: EFFECT OF BENIGN PELVIC TUMORS UPON THE UPPER URINARY TRACT: SIZE OF THE TUMOR

Diameter →	10 Cm.	15 Cm.	20 Cm.	25 Cm.	30 Cm.
Number	50	29	12	3	2
Ureters affected	29 (58%)	24 (83%)	9 (75%)	3 (100%)	1 (50%)
Not affected	21 (42%)	5 (17%)	3 (25%)	0	1 (50%)

of ureteral obstruction, displacement, or both. Obstruction occurred in 46 (47.9 per cent), displacement in 12 (12.5 per cent), and both obstruction and displacement were present in 8 (8.7 per cent).

Myomas of the uterus were encountered in 77 patients; 14 patients had ovarian cysts, and 5 had both a myoma and a cyst. Abnormal urographic changes were observed in 56 patients (72.5 per cent) with myomata, 6 (43 per cent) with ovarian cysts, and 4 (80 per cent) with both cyst and myoma (Table I).

A correlation of the size of the tumor as found at operation and the incidence and displaced the right kidney upward, but it did not produce an obstructive uropathy. In another patient with a large and partly calcified myoma which extended high above the level of the pelvic inlet, no ureteral changes were observed (Fig. 1).

We believe that the position of the tumor in relation to the pelvic ureter is more important than its size. In our series, the impacted or the intraligamentous tumors produced the highest evidence of alterations in the urinary tract (Table III). In fact, it was unusual to find an intraligamentous cyst or fibroid

which did not produce abnormal manifestations (Fig. 2). We were unable to corroborate the observations of Kretschmer and Kanter, who showed that the cystic tumors produce a higher incidence of alteration of the urinary tract than the solid tumors.

What are the urinary tract lesions which one may expect as a result of mechanical pressure by a pelvic mass? From our experience in this series of patients, the changes seen on the urograms were qualitatively similar to those seen during pregnancy but were rarely so pronounced. Dilatation of the ureters, when present, was seen always at the level of the pelvic inlet or slightly above. This dilatation was usually bilateral, often producing greater changes on the right side (Fig. 3). In the more pronounced cases of obstruction, the ureters were widened, elongated, and redundant above the point of obstruction, and the renal pelvis and calices showed evidence of back pressure. In the milder cases, only the upper ureter showed moderate or slight dilatation. We have observed but one patient who had a severe degree of hydronephrosis as a result of a benign pelvic tumor. In no instance did we see complete absence of function of one kidney such as may occur with advanced malignant growth in the female pelvis.

Different degrees of delayed transportation were seen with different positions of the patient on the roentgenographic table. In some instances, with the patient in the supine or Trendelenburg, position, moderate dilatation of the upper ureters was easily demonstrable, but in the erect posture the upper ureters would empty and the renal pelves and calices would return to normal appearance. When, however, the tumor was fixed within the pelvis, the obstructive phenomena were more pronounced and persistent in all positions.

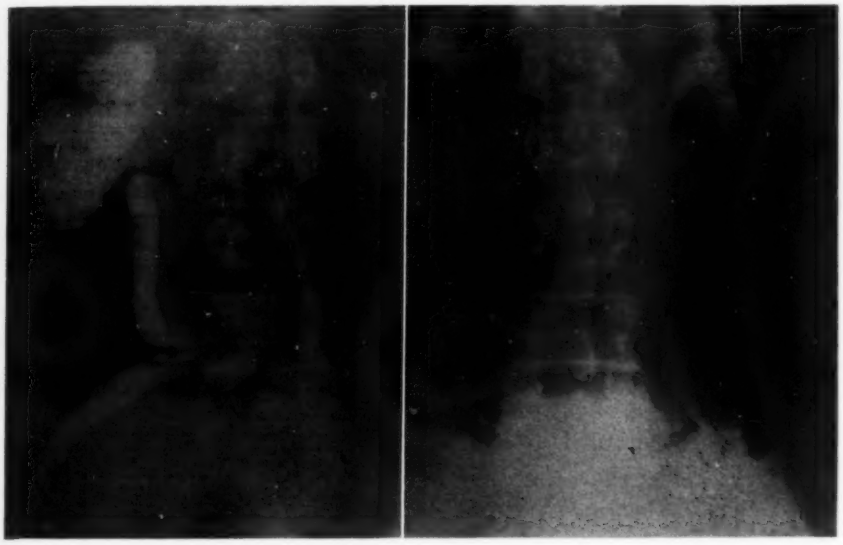

Fig. 2. Intraligamentous cyst producing ureteral obstruction on the right side. This was the most severe obstruction seen in any of our patients.

Displacement of the pelvic portion of the ureter, when present, was most often lateral. In only a few instances was the pelvic ureter straightened in a vertical direction by the mass, which appeared to fix it in position.

One of the most interesting phases of this investigation proved to be the comparison of the preoperative and postoperative urograms. The latter were made

Fig. 3. Mild obstructive uropathy produced by myoma uteri. The right ureter is dilated and elongated above the iliac vessels. The pelvis and calices are normal.

from eight to sixteen weeks after operation. In all instances a return to normal function was demonstrated. Continued comparison of the two sets of films frequently brought out minor preoperative changes that might well have been overlooked. One striking feature of the follow-up urograms was their poor diagnostic quality for morphological changes, compared to the preoperative films. Without the pelvic mass the transportation of dye was rapid, and recording of filling of the renal pelves and calices was consequently often not obtained. This lends emphasis to the statement that the anatomical outlines of the *normal* urinary tract are frequently the most difficult to demonstrate by excretory urography.

It is not within the scope of this paper to discuss the urinary tract changes which occur with pregnancy. Excellent publications of Hundley *et al.* (2), of van Wagenen and Jenkins (5), of Lee and Mengert (4), and many others, have indicated the important role of hormones in the production of such changes. Microscopic studies show definite alterations in the ureters during pregnancy. Ureteral changes similar to those in pregnancy, but somewhat less pronounced, were observes on urographic examination in 96 cases of benign pelvic tumor in non-pregnant women. The development of these changes in the absence of the hormonal stimulation of pregnancy indicates that external pressure is capable of producing them and suggests that pressure must play an important role in the dilatation that occurs in the pregnant woman.

In this series the urographic findings gave no lead as to the type of pelvic tumor. A number of instances of early malignant change in myomata or ovarian cysts were met. While they were excluded from this group, survey of the urograms shows nothing distinctive. On the other hand, extensive malignant growths in the pelvis, particularly of cervical origin, are recognized as frequently influencing ureteral function. Absence of function of one kidney in association with a pelvic tumor is indicative of extensive malignant growth, while simple displacement or partial blockage, although it does not refute the presence of an early malignant neoplasm, is more likely to result from a benign pelvic tumor.

CONCLUSIONS

Ninety-six patients with benign pelvic tumors were studied by excretory urography before and after removal of the tumors.

Urinary tract changes—obstruction, displacement, or both—were present in 66 patients. These changes are discussed in relation to the type, size, and position of the tumor and the position of the patient at the time of the examination.

All of the changes disappeared completely following removal of the tumors.

There is evidence that pregnancy changes in the urinary tract are partly due to mechanical pressure.

Excretory urography is a valuable preoperative study in all patients with benign pelvic tumors.

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DISCUSSION

George H. Gardner, M.D. (Chicago, Ill.): Doctors Payne and Chamberlin have presented further evidence that benign tumors of the female genital organs may be accompanied by disturbances in the ureters—either dilatation or distortion or both. Obviously these ureteral changes are due to mechanical pressure by the tumors on the ureters. One would expect, therefore, to find the highest incidence as well as the most marked degree of ureteral dilatation and distortion in association with broad ligament tumors and those which are incarcerated in the pelvis.

It is amazing that the authors encountered such a high percentage of ureteral changes—70 per cent—in their series of 96 women with uterine fibroids and ovarian cysts. These findings, however, are chiefly of academic interest, since their patients did not present either signs or symptoms of urinary tract disease, and all of the postoperative urograms revealed a return of the ureters to normal. Furthermore, you as radiologists might disagree with the authors in their diagnosis of ureteral dilatation in some of the borderline preoperative urograms. At any rate, clinicians recognize a considerable latitude both in the diameter of the normal ureter and in the radiologist's interpretation of urograms.

I wish that the authors had commented on the parity of their patients, since they state that their findings are qualitatively comparable to the changes which occur during pregnancy. It seems likely that a multiparous woman with a pelvic tumor would be more likely to show urographic evidence of ureteral dilatation than a nulliparous woman with a similar tumor. I have never been certain that the ureteral changes of pregnancy always disappear completely after the puerperium. It seems probable that there is sometimes slight residual atony of the ureters. This might be increased with each subsequent full-term pregnancy. In consequence, multiparae would be more likely to present ureteral dilatation with lesser degrees of pressure by pelvic tumors.

It would have been of interest to have had a description of the preoperative cystograms in these cases. Undoubtedly the bladder is frequently both displaced and distorted by uterine fibroids. At any rate, I can conceive of situations in which pressure by subvesical fibroids might lead to ureteral dilatation.

I wish, also, that the authors had reported about their patients' blood pressure before and after operation. It would be significant if the woman with hypertension were shown to have a lower pressure after removal of her tumor and return of the ureters to normal.

Finally, I doubt that intravenous urography is of momentous value as a preoperative procedure in women with large incarcerated or intraligamentary tumors. Too often that portion of the ureter which is compressed or displaced and thus might be injured during the operation does not appear in the urogram. There are more effective methods of demonstrating the exact location of a ureter, as by stereoscopic study of retrograde pyelo-ureterograms or by leaving ureteral catheters in place so that they can be palpated during operation.

The operator who is so cautious that he requests preoperative urography rarely traumatizes a ureter at the operating table. He knows that certain types of benign tumors tend to displace the ureter and he identifies this gynecologic *bête noire* before removing the tumor.

Doctor Chamberlin (*closing*): I want to thank Doctor Gardner for his excellent discussion. He certainly lost no time in finding our weak spots. We do not have any data on the parity of these patients and I quite agree with him that this would be interesting. Most of them, I believe, were multiparae, but the urograms following the removal of the tumor failed to show any evidence of multiparity or of any abnormal physiology—at least so far as we have observed—in the urinary tract.

The question of pressure on the bladder Doctor Payne felt was not really important, so that was not included in the paper.

In a few of our cases the lower ureter was fixed in a straight line rather than rounded in the lateral direction by a fixed intraligamentous mass in the pelvis, but in most cases the lower ureter was displaced.

It is quite true that the weakness of this method is that in many cases where an intraligamentous or incarcerated tumor is present in the pelvis, the lower ureter cannot be identified, but if it can be, Doctor Payne feels that the roentgenogram is of great assistance to him in the operating room.

Entero-Enteric Intussusception[1]

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USE OF THE roentgen rays as an aid in the diagnosis of intussusception was first reported by Ladd in 1913. Shortly thereafter, in 1914, other reports by Lehmann and by Groedel appeared in the literature. Since that time excellent articles on the subject have been written by Davis and Parker, Sussman, Kirsner and Miller, and Ochsner and Gatch. For the most part these reports have dealt with the colocolic and ileocolic types of intussusception, and have described their roentgenologic characteristics as encountered during administration of a barium enema. It is the purpose of the present report to call attention to the roentgenologic characteristics of the entero-enteric type of intussusception as demonstrated after the administration of barium suspension by mouth.

Intussusception can be divided into colocolic, ileocolic (including ileocecal), and entero-enteric types according as it involves the colon, the ileum and colon in the region of the ileocecal valve, or the small intestine alone. Freilich and Coe, who reviewed 3,284 cases of intussusception, found that the entero-enteric type accounted for only 14 per cent of the total number. The most common type, ileocolic, is seen most often among infants less than two years of age and usually is characterized by a sudden onset (12). Entero-enteric intussusception, on the other hand, is frequently a disease of adult life and often is chronic in nature.

Although there are isolated reports in the literature (13) of spontaneous intussusception of the small intestine among adults, in the majority of instances some underlying lesion is present. The most common cause is tumor, either benign or malignant. In a third of 300 cases of intussusception in adults, collected from the literature by Eliot and Corscaden, tumor was the exciting factor. Invagination of Meckel's diverticulum is next in frequency, a point emphasized by Harkins, who collected reports of 160 cases from the literature. Among other lesions which have been reported are enlargement of a mesenteric lymph node (10), ulceration of a Peyer's patch, stenosis, and adhesions (2).

Whereas the symptomatology of acute ileocolic intussusception occurring in infancy usually is characteristic, that of the chronic entero-enteric type in an adult frequently is atypical and bizarre. Wangensteen, in discussing the diagnosis of this condition, stated that "it is just in this type [entero-enteric] that help is most needed; for the appearance of blood in the stool is a late occurrence, and the tumors being small are often not palpated."

As has been pointed out by many observers (1, 7, 11, 14), when intussusception is encountered during the administration of a barium enema, several characteristic features are noted. Obstruction to retrograde filling is almost always met, but the site of obstruction may recede in the face of the advancing enema (Fig. 1). A mass which coincides with the site of obstruction and which recedes with it is frequently palpable. After evacuation of the enema, the mass and the site of obstruction may be found to have advanced again. This change in position is due to the fact that intussusception tends to be reduced and to recur as a result of the action of peristalsis and of the changing pressures within the bowel.

At the site of obstruction a filling defect is seen which has been variously named "cupola effect," "pincer effect," "inverted U," "beak effect," and "spiral sheath" (Fig. 2). These names all describe stages of the same phenomenon, namely, the filling with barium of the space between the

[1] Presented before the Radiological Society of North America, at the Twenty-eighth Annual Meeting, Chicago, Ill., Nov. 30–Dec. 4, 1942.

receiving layer of bowel (intussuscipiens) and the invaginated portion (intussusceptum). The amount of filling is regulated by the differential in pressure between the forces of the enema and the swelling and edema of the two layers of bowel. Sometimes the opaque material proceeds through the narrow channel of the invaginated portion and fills the normal bowel orad to the lesion. More often this does not take place unless intussusception has been completely reduced by the pressure of the enema.

Fig. 1. Ileocolic intussusception caused by myxoma of the ileum. Obstruction to the barium enema is encountered in the region of the transverse colon. At the time of roentgenoscopic examination the site of obstruction was seen to recede for a short distance toward the hepatic flexure.

When intussusception is approached from the end of the intussusceptum (and in most instances this is accomplished by means of a barium suspension given by mouth), different roentgenologic characteristics are noted. Obstruction in some degree is always present. Usually, this takes the form of a gradual narrowing of the lumen of the bowel without interference with the normal mucosal pattern until the intussusceptum is reached (Fig. 3*a* and *b*).

Fig. 2. Ileocolic intussusception (same lesion as that shown in Fig. 1) after evacuation of the enema. The characteristic "cupola" or "pincer effect" is well shown.

Here the channel narrows to an extent dependent upon the amount of swelling and edema in the involved tissues. In the patient who has complete obstruction this channel may be occluded. More frequently it is a few millimeters in diameter.

Usually, a mass is palpable at the site of obstruction, just as in the case of an intussusception encountered during examination by means of a barium enema. This mass, however, less frequently recedes in front of the advancing column and seldom recurs if the intussusception is reduced during the course of the examination.

As the column of barium advances and after it has proceeded through the narrow channel of the intussusceptum, it may be seen to widen out into the normal portion of bowel. At the same time some of the opaque material passes in a retrograde manner into the space between the walls of the intussusceptum and the intussuscipiens. This results in formation of the

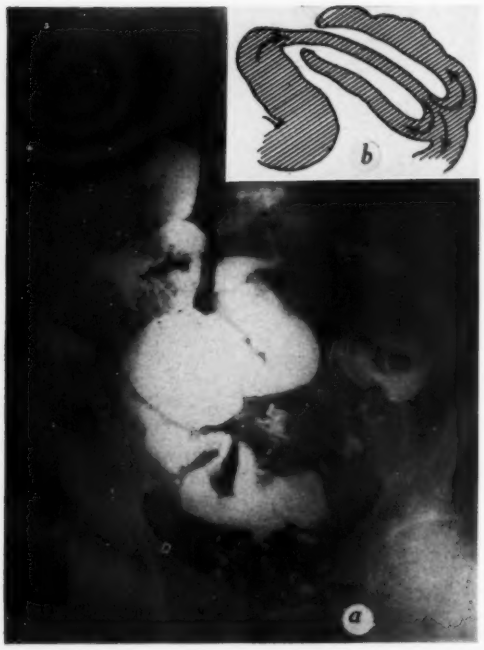

Fig. 3. Case 1: *a*. Entero-enteric intussusception caused by an invaginated Meckel's diverticulum; the lumen of the ileum narrows as the intussusceptum is approached. *b*. Diagram showing the mechanism of intussusception. The shaded areas represent barium within the lumen of the bowel.

"spiral sheath" or "concentric ring" appearance (Fig. 4*a*), which is the end stage of the "pincer effect" described by various authors (1, 11, 14) dealing with examination by means of the enema.

In some instances, barium cannot be seen to fill the narrow channel of the intussusceptum, in which case the diagnosis is dependent upon recognition of the initial narrowing of the stream and the abrupt demarcation of the "spiral sheath." The diameter of this sheath is always considerably larger than the diameter of the lumen of the bowel as it approaches the sheath.

Since in most cases entero-enteric intussusception occurs as the result of some exciting factor, it would be advantageous to be able to recognize the underlying cause by means of the roentgenologic examination. Experience has shown, however, that this goal is seldom attained. In most instances, when a diagnosis of entero-enteric intussusception is reached as a result of roentgenoscopic or roentgenographic observation, the causative factor remains obscure. Infrequently the examiner may recognize not only the intussusception but also the primary lesion.

Reports follow of three cases in which the roentgenologic observations were typical of entero-enteric intussusception. In each instance the diagnosis was reached before operation, and in each the barium suspension was given by mouth. Case 1 and Case 2 have been reported before (4).

REPORT OF CASES

CASE 1: A man 31 years old complained of intermittent cramping pains in the upper portion of the abdomen. He had first noticed the pain four months previous to examination and he believed that it was becoming progressively more severe. The pain extended toward the left side and was worse an hour after meals. Two months before registration the patient had passed a large, dark stool. On several occasions fresh blood had been observed in the stools. During the four months of illness there had been a weight loss of 25 pounds (11 kg.). Except for detection of slight epigastric tenderness, results of the physical examination were not remarkable. No masses were felt. Laboratory tests revealed severe anemia (2,780,000 erythrocytes per cubic millimeter and 8.4 gm. of hemoglobin per 100 c.c. of blood).

Results of roentgenologic examination of the colon were negative for pathologic processes. Roentgen examination of the small intestine by means of the opaque meal disclosed intussusception in the ileum about 2 feet (61 cm.) from the ileocecal valve (Fig. 3*a* and *b*).

Surgical exploration by Dr. J. deJ. Pemberton showed the intussusception to involve about 2 feet (61 cm.) of ileum and to be the result of an invaginated Meckel's diverticulum which contained atypical gastric mucosa. The intussusception was reduced, the diverticulum was removed, and lateral anastomosis was done.

CASE 2: A man 61 years old was examined on Jan. 24, 1941. He had been seen twice before, in 1929 and in 1930, and on the latter occasion cholecystectomy had been performed because of gallstones. He had been well since that operation until six months before his most recent registration, at which time he complained of pyrosis and flatulence, which were most severe three or four hours after meals. In October 1940, he had passed a black, tarry stool, an incident which had been followed six weeks later by midabdominal pain. His home physician had found him to be anemic and had discovered occult blood in the stools. There had been a

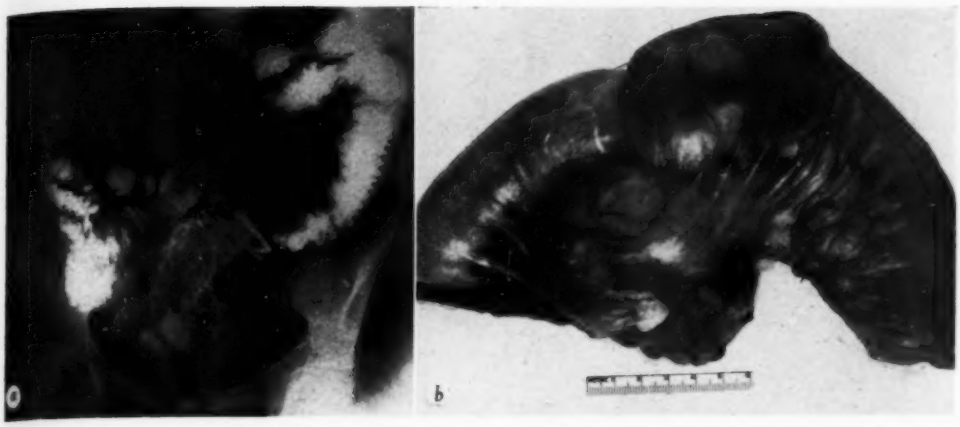

Fig. 4. Case 2: *a*. Entero-enteric intussusception caused by an adenocarcinoma of the jejunum; the "spiral sheath" or "concentric ring" appearance is well shown, as is the narrow channel through the intussusceptum. *b*. Removed segment of jejunum with mesentery.

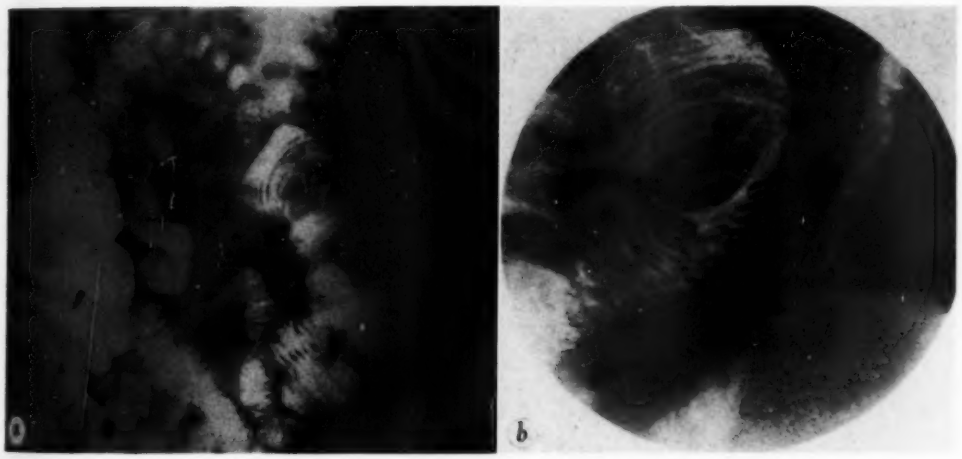

Fig. 5. Case 3: *a*. Entero-enteric intussusception caused by leiomyosarcoma; the "concentric ring" appearance and the difference in diameter between the involved and uninvolved jejunum are characteristic. *b*. "Spot" radiograph of the lesion.

weight loss of 3 pounds (about 1 kg.). Pallor, epigastric tenderness, and a pulsating, tender mass in the lower part of the abdomen were noted on physical examination. Laboratory tests revealed microcytic hypochromic anemia (3,160,000 erythrocytes per cubic millimeter and 7.6 gm. of hemoglobin per 100 c.c. of blood) caused by chronic loss of blood.

Roentgenologic examination showed the stomach and colon to be normal. On roentgenoscopic observation of the small intestine after ingestion of a barium meal, intussusception was found in the jejunum about 2 feet (61 cm.) from the ligament of Treitz (Fig. 4*a*). This lesion corresponded to the movable mass palpated in the abdomen.

Surgical exploration by Dr. V. S. Counseller showed an adenocarcinoma to be present in the jejunum about 2 feet (61 cm.) from the ligament of Treitz, with involvement of the regional mesenteric lymph nodes (Fig. 4*b*). The tumor had caused intussusception of 6 cm. of bowel. Resection and end-to-end anastomosis were performed.

CASE 3: A man 57 years old complained of weakness and indigestion. For one year he had experienced mild pain and a sensation of fullness in the epigastric region. On several occasions he had passed tarry stools, and his family physician had found him to be anemic. On physical examination the only finding of significance was pallor. No

Fig. 6. Case 3: Removed segment of jejunum showing both the intraluminal and extraluminal portions of the dumbbell-shaped leiomyosarcoma seen roentgenologically in Fig. 5*a* and *b*.

masses were felt. Laboratory tests revealed a microcytic hypochromic anemia (2,060,000 erythrocytes per cubic millimeter and 4.7 gm. of hemoglobin per 100 c.c. of blood). Occult blood was present in the feces.

Roentgenologic examination showed the esophagus, stomach, and colon to be normal. A lesion was found on roentgenoscopic examination of the small intestine (Fig. 5*a* and *b*). The roentgenologic report was: "Intussuscepting lesion in upper jejunum. This is undoubtedly tumor with associated intussusception."

At surgical exploration Dr. Waltman Walters found a dumbbell-shaped tumor of the jejunum, which he removed (Fig. 6). The pathologist's report was "Grade 1 leiomyosarcoma in a leiomyoma (7 × 6.5 × 4 cm.) arranged in a dumbbell shape with the submucous and subserous prolongation of the neoplasm connected by a constricted midportion extending through the jejunal wall." At the time of operation intussusception was not noted.

CONCLUSIONS

1. Although entero-enteric intussusception occurs less frequently than other types, its recognition by the roentgenologist is of greater value than his recognition of the others since the clinical signs are not often diagnostic.

2. The chief roentgenologic characteristics of this condition, when encountered during the course of examination after the administration of a barium suspension by mouth, are: (1) gradual narrowing of the lumen of the bowel as it approaches the intussusception; (2) marked narrowing of the lumen through the intussusceptum; (3) retrograde filling of the space between the intussusceptum and the intussuscipiens, with formation of a characteristic "concentric ring" or "spiral sheath" appearance; (4) a palpable mass coincident with a filling defect in the barium column.

3. Entero-enteric intussusception usually is secondary to some other lesion of the bowel, but the roentgenologist is seldom able to identify this lesion even after he has recognized the intussusception.

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DISCUSSION

Grant H. Laing, M.D. (Chicago): There are three points that I would like to make in connection with Doctor Good's paper. One is impressed in reviewing these cases by the periodicity of attacks and wonders if these recurrent episodes do not represent "minor intussusceptions." In such instances after the acute episode the bowel resumes its normal position, and when the patient gets to the roentgenologist he finds no definite evidence of intussusception.

The second point that I want to make is in connection with edema. Doctor Good brings out the fact that there is a narrowing of the intussusceptum. This narrowing is probably accounted for in great measure by the edema. So that if there is a large amount of edema there may be marked narrowing and the symptoms are those of obstruction. Thus it would be very difficult for the roentgenologist to tell whether he had an intussusception or not, and he would make a diagnosis of an acute obstruction in these cases.

The third point is hemorrhage. We teach, and we have been taught, that bright red blood ordinarily comes from low down in the gastro-intestinal tract and that dark blood or tarry stools come from higher up. This is the usual thing; but in some of these cases, and one especially shown by Doctor Good, there is bright red blood coming from rather high in the tract. With the irritability that occurs in the intestine at this time, relatively small amounts of blood can be shunted from high up in the gastro-intestinal tract and still be bright red. In these cases the bleeding is not due to gross ulceration but is the result of capillary hemorrhage, and thus the clinician especially must not think necessarily of the pathology being low down because there is bright red blood in the stools.

If we are to have any progress in the refinements of diagnosis, there must be closer co-operation between the clinician and roentgenologist, and after hearing such a paper as Doctor Good's, we can certainly feel that we have gone far in this direction.

Doctor Good (*closing*): I should like to bring up one point which has not been covered, namely, the danger of giving barium by mouth to a patient suffering from intestinal obstruction. As a general rule, it is safe to give barium orally if there is no obstructing lesion in the colon. If an obstruction is present in the small intestine, the barium may be removed by suction. However, barium impacted behind an obstructing lesion of the colon cannot be reached by the suction tube and occasionally perforation of the cecum will take place.

It is a good practice, therefore, to examine the colon by means of a barium enema before attempting to study the small intestine. In the event the colon shows no lesion, examination of the small intestine may be carried out with relatively slight risk.

Dyschezia and Megacolon[1]

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THIRTY-THREE years ago I suggested that all cases of constipation could be separated into two groups: (1) colonic constipation, in which the passage through the colon is delayed, and (2) dyschezia (δυς difficult; χέζω, I go to stool), in which the faeces reach the rectum at the normal rate but their final evacuation is delayed owing to inefficient defaecation. Since that time the concept of dyschezia has become almost universally accepted, so that it was something of a surprise to read in the December 1941 issue of RADIOLOGY a paper by Delano, Ronayne, and Boland entitled "Rectal Dyschezia: A Misnomer for Megarectum." Although they regard the term dyschezia as "inept" and "obsolescent" and add that they have probed for diagnostic criteria or notes on etiology, it would appear that they have not read a single one of the numerous papers which have been written on the subject since the original publication of my monograph on *Constipation* in 1909. There had, in fact, never been any confusion between dyschezia and megacolon until the paper by Delano and his colleagues appeared.[2]

In 1919 I pointed out the similarity between megacolon and megaesophagus and suggested that the former is a result of achalasia (absence of relaxation) of the anal sphincter secondary to disease of Auerbach's (myenteric) plexus (Hurst, 1936), a view which has been confirmed by all recent writers on the subject.

I propose here to give a short account of both dyschezia and megacolon.

DYSCHEZIA

Normal defaecation depends on a conditioned reflex. An infant is trained to open his bowels when he is put on a chamber, no mental process being concerned in the act. In the course of time an elaborate conditioned reflex develops, in which getting up, a bath, dressing, breakfast, and finally sitting down with a newspaper and a pipe in the familiar w.c. take part. As a result of this, a strong mass peristaltic wave passes along the colon, and the feces which have collected in the pelvic colon enter the rectum, which has been empty since the last act of defaecation. The consequent distention of the rectum gives rise to the perineal sensation which constitutes the "call to defaecate." The diaphragm and abdominal wall are then voluntarily contracted, and the rise in pressure within the rectum calls forth the final reflex, which results in contraction of the rectum and relaxation of the anal sphincter, through which the faeces are evacuated.

Many cases of constipation formerly regarded as colonic are caused by inefficiency of the conditioned reflex, which should result in the partial evacuation of the contents of the proximal part of the colon into the pelvic colon as well as of the contents of the pelvic colon into the rectum. In most cases of dyschezia this conditioned reflex is unimpaired, but for various reasons it is not followed by the defaecation reflex proper, in which the rectum contracts and the anal sphincter relaxes, so that the rectum is found to be packed with faeces at whatever hour it is examined. Dyschezia often originates in neglect to respond to the call to defaecate, owing to laziness, insanitary conditions, or false modesty. The double reflex becomes progressively impaired. The rectum dilates so that an increasing quantity of faeces is required to attain the adequate internal pressure necessary to produce the call to defaecate, and finally the sensation is lost completely. The patient, however, is still capable of emptying his rectum if he tries, but by

[1] Accepted for publication in June 1943.

[2] An opportunity has been given Dr. Delano to defend his position. See page 190.—ED.

this time he has generally convinced himself that he cannot get his bowels opened unless he takes a sufficient dose of aperient to produce fluid faeces which require no effort for evacuation.

Dyschezia may also result from weakness of the voluntary muscles of defaecation, assumption of an unsuitable posture during defaecation, and voluntary inhibition from fear of pain in diseases of the anal canal. But whatever the primary cause, the final result is the same. The defaecation reflex is lost, and incomplete evacuation results in the accumulation of faeces in the rectum.

Symptoms: In dyschezia the retention of solid faeces in the rectum, which is normally empty except immediately before defaecation, may give rise to a number of reflex symptoms, such as headache and general malaise, which disappear directly the bowels are opened. The instantaneous relief proves that these symptoms are not caused by auto-intoxication. Moreover, experimental distention of the rectum with a large plug of wool produces identical symptoms. Pressure on the surrounding parts by the retained faeces also gives rise to perineal discomfort. Pressure on the haemorrhoidal veins may be the exciting cause of haemorrhoids, and the passage of large hard scybala through the anal canal may produce an anal ulcer.

The irritation of the mucous membrane of the pelvic colon and rectum when hard faeces are retained for long periods gives rise to excessive secretion of mucus. This is the normal response of the healthy mucous membrane to mechanical irritation and is the result of a protective reflex. Under such conditions a diagnosis of "mucous colitis" has no justification, as proctoscopy reveals a healthy mucous membrane and the mucus contains no inflammatory cells.

Diagnosis: Before a self-made diagnosis of constipation can be accepted, it is necessary to ascertain what happens to the patient under natural conditions, for the majority consult a doctor only after they have begun to treat themselves with aperients. They regard themselves as constipated because they take aperients, though frequently their bowels would act sufficiently without artificial aid. The patient should therefore be instructed to take no aperient and to make an effort to open his bowels every morning after breakfast, even if he feels no inclination to do so. He generally succeeds and it is then clear that he is not constipated at all and that both the local and general symptoms of which he complains are the result of purgation. If, on the other hand, the bowels are not opened, the abdomen and rectum should be re-examined: an empty colon and a full rectum indicate the presence of uncomplicated dyschezia. If the rectum is empty and hard scybala can be felt in the pelvic colon through the anterior rectal wall, pelvic colon dyschezia is present.

In severe cases the diagnosis should be confirmed and amplified by an x-ray examination, carried out after an opaque meal while the patient is taking no aperient. In dyschezia the passage through the colon is found to be at the normal rate or even more rapid than normal, all the barium collecting in the rectum or rectum and pelvic colon in twenty-four hours.

Treatment: Dyschezia can be cured by restoring to activity the defaecation reflex, which has been allowed to become inefficient by neglect and by interference with its normal performance by the habitual use of aperients. A simple explanation of the physiology of defaecation and encouragement are often all that is required, but it may be necessary to reduce the work the muscles of defaecation have to perform by giving liquid paraffin or an unabsorbable vegetable mucilage to increase the bulk and soften the faeces, together with a diet containing plenty of fruit and green vegetables.

When the patient is quite unable to evacuate the rectum although it is loaded with faeces, an enema of one fluid ounce of glycerine should be given in the morning after an unsuccessful effort has been made. The strength of the enema should be gradually reduced by replacing one fluid drachm of glycerine by water every other day until

only water is used. By this time the normal defaecation reflex and with it the tone and contractile power of the rectum have almost invariably returned.

MEGACOLON

Megacolon is a condition in which the rectum and pelvic colon, and sometimes the whole of the large intestine, are dilated and hypertrophied although no organic obstruction is present. The name Hirschsprung's disease, which is often used to describe megacolon in children, should be discarded, as at least four papers on the subject were published before 1888, when Hirschsprung's appeared, and no clear dividing line can be drawn between the megacolon of children and that of adults.

Megacolon must be distinguished from an abnormally long colon, so-called dolichocolon. The pelvic colon varies greatly in length but, although a very long pelvic colon may predispose to volvulus, there is no reason to believe that it predisposes to megacolon.

Megacolon in children is rare; I have seen only 11 cases compared with 38 in adults. In children it occurs almost exclusively in boys (10 out of 11 of my cases), whereas in adults the incidence is about equal in the two sexes (20 males and 18 females in my series). It is probable, therefore, that the majority of cases observed in adults do not date from childhood.

Pathogenesis: Achalasia of the Sphincter ani: I believe that the primary factor in the pathogenesis of all cases of megacolon is achalasia (*α*, not; *χάλασις*, relaxation) of the sphincter ani, *i.e.*, absence of the relaxation of the sphincter which should occur when the rectum contracts during defaecation. This is sufficient to prevent the easy evacuation of faeces, which are consequently retained.

The pelvic colon and rectum attempt to overcome the resistance offered by the closed anal sphincter by increased peristalsis, with the result that their walls gradually become hypertrophied. The thick walls of the fixed rectum give way less readily than the comparatively thin walls of the freely movable pelvic colon, so that the rectum does not show the same degree of dilatation and in many cases it is only slightly enlarged. The distention of the pelvic colon results in an increase in its length as well as in its diameter. As it contains a great excess of gas, the dilated and elongated loop rises during the day when the individual is in the erect position, and eventually its upper extremity generally reaches the left dome of the diaphragm. The extreme degree of hypertrophy and dilatation does not as a rule extend beyond the pelvic colon, though a lesser degree is often present in parts or in all of the rest of the colon.

The pelvic colon, rectum, and internal sphincter of the anus have, like the rest of the alimentary tract, a double nerve supply, sympathetic from the 2d, 3d, and 4th lumbar ganglia, and parasympathetic from the 2d, 3d, and 4th sacral nerve roots. The latter have a cell station in the ganglia of Auerbach's (myenteric) plexus. Stimulation of the sympathetic nerves causes relaxation of the pelvic colon and rectum and spasm of the sphincter ani, and stimulation of the parasympathetic nerves causes contraction of the pelvic colon and rectum and relaxation of the sphincter. The achalasia of the anal sphincter which results in megacolon is the result of parasympathetic paralysis caused by inflammation, atrophy, or fibrosis of Auerbach's plexus (Cameron; Robertson and Kernohan; Etzel), corresponding with the similar changes always found in the oesophagus in achalasia of the cardia (so-called cardiospasm) (Hurst and Rake, 1930; Hurst, 1943).

Secondary Obstruction at Pelvi-Rectal Flexure: If at the onset of the disease the fold of mucous membrane at the pelvi-rectal flexure is unusually prominent, the dilatation of the pelvic colon immediately proximal to it may exaggerate the kink. Although the primary condition is still the anal achalasia, the secondary obstruction caused by the kink at the pelvi-rectal flexure prevents the entry of gas and faeces

into the rectum so that it does not join in the progressive dilatation of the pelvic colon. The varying degree in which this secondary obstruction occurs accounts for the fact that in some cases the rectum either is not appreciably dilated or is only slightly dilated compared with the pelvic colon. In spite of this, it always appears much enlarged when an opaque enema is given. This shows that it must have been greatly distended at first, but that, when the pelvi-rectal kink developed and gas and faeces ceased to accumulate in the rectum, it contracted without, however, losing the abnormal distensibility caused by the earlier distention.

In the majority of cases a sigmoidoscope can be passed its full length of 12 inches blindly without meeting any resistance, whereas in normal persons it is rarely possible to pass it beyond the pelvi-rectal flexure without having to withdraw the obturator and guide the instrument by direct vision. Endoscopy shows the end of the instrument in the centre of an enormous cavity. On withdrawing it, no dividing line can be recognized between the pelvic colon and rectum, the dilatation of which extends to the entrance of the anal canal.

Symptoms: In children with megacolon there is almost always a history of constipation dating from birth or from the first few months of life. At an early stage the bowels cease to act spontaneously, and drugs gradually lose their effect until an evacuation can be produced only by means of enemas. Sometimes the bowels are opened daily, but the quantity passed is never sufficient, so that large accumulations of faeces collect in the distended colon. The stools are generally soft, but in less severe cases scybala may be passed.

Soon after the onset of constipation the abdomen, which at birth is normal in appearance, begins to increase in size owing to distention of the pelvic colon with gas and faeces, the size varying from time to time according to the extent to which the bowels are opened. Enormously dilated segments of colon can often be recognized through the thin and stretched abdominal wall; they are dull on percussion, and palpation shows that they are filled with soft faeces. Digital examination of the rectum is painless; the anal canal offers no more than the normal resistance and there is no hypertrophy of the sphincter. The rectum is generally much dilated and filled with soft faeces or less often with a large solid faecal ball. If secondary obstruction has developed at the pelvi-rectal flexure, the rectum is empty and faeces can be felt in the pelvic colon through its anterior wall.

With proper treatment the child is able to lead a normal life and is free from symptoms of toxaemia, but if he is neglected, enormous accumulations of faeces collect. Formerly, before the true nature of the condition was recognised, the bowels sometimes ceased to act at all and death occurred from chronic faecal obstruction.

The gas in the dilated pelvic colon is under considerable pressure. In small children it pushes the diaphragm up and the abdominal wall forwards, but in older children and in adults the appearance of the abdomen is generally less abnormal and is sometimes quite normal, as the diaphragm, which does not receive any support from above owing to the negative intrathoracic pressure, gives way before the abdominal muscles. The increase in the capacity of the upper part of the abdominal cavity produced in this way provides sufficient space for the greater part of the dilated colon.

Megacolon is compatible with perfect health. The majority of my adult patients came for advice on account of nothing more than constipation, which was generally no more severe than that occurring in many persons without any organic disease, and the abdomen was not obviously distended. In 5 patients the condition was accidentally discovered in the course of a routine investigation on account of abdominal symptoms caused by some other condition.

Toxic symptoms do not develop unless aperients have been taken in excess. Megacolon does not appear to endanger

life; 16 of my 36 private patients were over fifty and an additional 9 were over forty when I first saw them, although the condition had presumably been present for many years, if not from infancy.

All the children with megacolon I have seen since 1920 are developing normally and appear to be none the worse either physically or mentally for having had a dilated colon. Two of them, who were first seen in 1923 with a pelvic colon extending to the diaphragm, are now flying officers and their bowels work regularly without artificial aid.

In a small proportion of cases the patient complains of sudden attacks of very severe pain with abdominal distention caused by partial volvulus of a loop of the long and dilated pelvic colon. Mild attacks in which the pain is not very severe and the distention is slight occur much more often. Either type of attack may last for anything between a few hours and a few days and almost always subsides spontaneously. In 2 of my patients, both men of over sixty, a carcinoma developed in the dilated colon.

Although the diaphragm is almost completely out of action and the capacity of the chest is much reduced, there is no complaint of dyspnoea. Several of my patients were able to take strenuous exercise and the majority were physically well developed. In most cases the left dome of the diaphragm alone is involved; it may reach the level of the third or fourth rib and is always higher than the right dome. In 2 cases the heart was pushed over to the right. In 5 the pelvic colon was so long and dilated that its upper extremity crossed the middle line after reaching the diaphragm on the left side and passed in front of the liver so as to intervene between its upper surface and the right dome of the diaphragm. Its gas-containing cavity was seen with the x-rays to be in contact with the diaphragm on both sides.

Radiological Examination: (*a*) *Preliminary Examination:* Every x-ray examination should begin with an inspection of the patient in the erect position before he has had an opaque meal or enema. The possibility of a megacolon is at once suggested by the discovery of "eventration of the diaphragm." The abnormally high position of the left dome of the diaphragm presents such a striking appearance that it can hardly be missed. It is generally possible in megacolon to recognise the outline of the enormously dilated air-containing loop of pelvic colon and to distinguish it from the gas bubble in the fundus of the stomach, which is always limited below by the horizontal upper border of the shadow of the gastric contents. When a gas-containing cavity is seen under the right dome of the diaphragm as well as the left, the diagnosis of megacolon is certain.

As the diaphragm in megacolon is displaced into what is normally part of the thoracic cavity, the condition present might with justice be called eventration of the diaphragm. This name, however, is generally reserved for a condition in which the high position of the diaphragm is the result of a congenital defect in its musculature rather than of an acquired exaggeration in the upward thrust from below. In congenital eventration the left half of the diaphragm is always involved alone; it is represented by a fibrous membrane containing only a few scattered muscle fibres, so that it is incapable of contracting. In deep respiration it moves passively up in inspiration and down in expiration, *i.e.*, in the reverse direction to the normal right half of the diaphragm. When the high position of the diaphragm is secondary to megacolon, there is a small movement in the normal direction.

The eventration of the diaphragm which results from maldevelopment of its musculature is very rare compared with that due to megacolon; I have seen only 2 cases of the former, compared with 49 of the latter. If the term eventration of the diaphragm is to be retained at all, it would be more logical to include all cases in which the diaphragm is abnormally high, instead of using it only for those in which there exists a congenital defect in development. Cases would then be classified as follows: (i) primary, due to maldevelopment of one-half of the diaphragm, always left-sided; (ii) secondary to atrophy following interference with the nerve-supply; this may occur on either side and is a result of (*a*) disease, most commonly secondary carcinoma, but occasionally primary carcinoma of the lung, tuberculosis, Hodgkin's disease, and aneurysm, or (*b*) therapeutic division or avulsion of the nerve; (iii) secondary to (*a*) *aërogastrie bloqué* (Hurst, 1938) or (*b*) megacolon

(*b*) *Opaque Meal:* An opaque meal does not help greatly in the diagnosis of mega-

colon, but it is a valuable corrective for the false conclusions which might otherwise be drawn from an examination after an opaque enema. It shows how much of the colon is undilated and also the degree of stasis present and where the stasis occurs. The small intestine is always normal. In most cases the large intestine as far as the end of the iliac colon at the brim of the true pelvis is normal in size and there is little or no stasis in it, although an opaque enema may have led to the conclusion that the splenic flexure is hugely dilated. The explanation of this is given below. When the barium passes beyond the iliac colon, it is lost in the cavity of the pelvic colon, small spots of opaque material being scattered over the whole of the enormous area it occupies. Stasis of varying degrees is always present in the pelvic colon. In well compensated cases, in which the bowels are opened daily, there is no delay in the evacuation of the greater part of the opaque meal, but a small quantity generally remains scattered through the pelvic colon for many days or even weeks.

(*c*) *Opaque Enema:* X-ray examination after an opaque enema is an essential part of the investigation of every case of megacolon. It is necessary to watch the fluid being run in, as it is otherwise impossible to interpret a radiograph owing to the large amount of overlapping of different segments of the bowel caused by the enormous dilatation of the pelvic colon. What is generally mistaken for a dilated splenic flexure is in almost every case the pelvic colon, which lies in front of and obscures a splenic flexure of more or less normal size. The fluid is seen to run straight upwards through a greatly dilated rectum and pelvic colon to the left dome of the diaphragm. Even if the rectum is not found to be dilated on digital examination, it is always distensible and no resistance to the passage of the enema into the pelvic colon is encountered; it is in fact often impossible to recognise where the rectum ends and the pelvic colon begins. After reaching the diaphragm, the fluid passes downwards again, but often not until it has made a more or less complicated loop, which may reach the right dome of the diaphragm in front of and above the liver. It finally reaches the left brim of the pelvis, where it passes upwards again along the iliac and descending colon to the splenic flexure. The splenic flexure, together with most of the transverse colon and all of the descending colon and iliac colon, is entirely obscured by the pelvic colon, which lies in front of it. The fluid passes without difficulty into the caecum. Very large quantities of fluid are required to render the whole colon visible, the pelvic colon alone holding 6 to 12 pints. The colon in children may require as much as 4 to 6 pints, and in babies 1 1/2 to 2 pints.

The size of the colon as shown in a radiograph taken after an opaque enema is no guide to its actual size nor its tonicity, but is an indication of its distensibility. It does not correspond with the condition present immediately before the enema is given, because the walls of the colon relax in order to allow more and more fluid to enter until the maximal size which has been present at any recent time is attained. This explains why the pelvic colon in a case of megacolon, in which more or less complete relief has followed treatment, often appears to be enormously enlarged when examined after an opaque enema, though any abdominal distention present previously may have disappeared and an opaque meal and sigmoidoscopic examination may show no abnormality.

Treatment: Before discussing the results of treatment, whether non-operative or operative, it is necessary to point out that improvement in function should be the main criterion of success. A colon which has once been over-distended for any length of time remains permanently over-distensible, even if the over-distention has been completely overcome and the lumen is perfectly normal. It is best not to give an opaque enema after treatment, however successful, unless the patient is previously warned that it may show no change, as the disappointment may lead to a relapse which is purely psychological in origin.

The main object in the treatment of megacolon is to lessen the resistance offered by the closed anal sphincter to the passage of faeces and gas. Rapid stretching of the sphincter is not as a rule effective, as it quickly contracts again to its original state. For a permanent result, the postural tone of the muscle fibres of the sphincter must be permanently reduced. This can best be attained by the use of a conical vulcanite bougie which is passed every morning just after the first attempt to open the bowels has been made. The bougie is perforated along its axis in order to allow gas to escape from the rectum. It is pushed slowly in as far as it will go without causing discomfort and kept in position for half an hour. Intelligent patients quickly learn to pass it for themselves, and the mother or nurse can pass it for children. A second attempt to defaecate is made immediately afterwards. At the end of about a week the bougie need be kept in position for only a quarter of an hour; at the end of a month it is passed on alternate days, then once a week, and finally it is used only in the event of a return of symptoms.

When a child with megacolon comes under treatment, there is generally a large accumulation of faeces in the pelvic colon and, in about 50 per cent of cases, in the rectum also. The latter are easier to treat, because, when the rectum is empty and a secondary kink has developed at the pelvirectal flexure, treatment of the anal achalasia does not help until the dilatation of the pelvic colon has been overcome by keeping it nearly empty for some time; its contents can then pass without difficulty into the rectum. In adults such an accumulation is less often found, though in neglected cases and in all of the comparatively small number which have come to necropsy huge quantities of faeces are present. In both children and adults there is always a very large accumulation of gas in the dilated segment of bowel. Before any permanent improvement can be attained, the faeces and gas must be evacuated as completely as possible. Aperients are quite useless, and enemas are not always effective, as a good deal of the water injected is often retained. In neglected cases in children the best results are obtained by evacuation under a general anaesthetic, partly by lavage with simultaneous abdominal kneading and partly by the finger, faeces being removed from the rectum after being pushed into it by pressure on the abdomen. The faeces are generally soft, but sometimes a secondary cause of obstruction is present in the form of a solid ball of faeces, which acts as a ball-valve in the rectum, and must be broken up and removed bit by bit before the colon can be emptied.

After the colon has been evacuated and the resistance offered by the anal sphincter reduced, the patient is generally able to get his bowels satisfactorily opened every day. No aperient should be given, but paraffin may be needed to prevent the faeces from becoming hard. In many cases no further treatment is required. Sometimes, however, especially if the dilatation has been excessive, there is still a tendency for faeces to accumulate in the pelvic colon in spite of the bowels being opened daily. It is then necessary to give an occasional enema. This need not be done more than once a week, and sometimes once a month is sufficient. In some cases the best results are obtained with a very large enema, as much as 8 or 10 pints being run in under low pressure; in other cases most of the water is retained when large quantities are given, and quite satisfactory results are obtained with a single pint.

When attacks of pain and distention, presumably due to partial volvulus, recur in spite of treatment, immediate relief can be often obtained by the passage of a flatus tube. If this fails and the pain is severe, morphine and atropine should be injected.

Surgery: Such operations as colostomy, ileo-sigmoidostomy, and colectomy, which were formerly practised in these cases, had a very high mortality and rarely led to any appreciable improvement, as the primary seat of obstruction, the anal canal, was left untouched. Occasionally, however, it may become necessary to remove a single loop of the pelvic colon which has formed a

chronic volvulus and gives rise to frequent attacks of acute pain from partial obstruction.

Recently various operations on the sympathetic nervous system—especially division of the presacral nerve and the 1st to the 4th lumbar roots of both sides and removal of the inferior mesenteric plexus—have been performed with the object of reducing the tone of the anal sphincter. This proved remarkably successful in boys, though quite useless for the megacolon of adults; but equally good results could be very much more simply attained by local treatment. The operation has the further disadvantage of being invariably followed in males by permanent loss of ejaculatory power and consequent sterility. In 1935 Stabins, Morton, and Merle Scott noticed that a number of children with megacolon, to whom a spinal anaesthetic had been given for diagnostic purposes before resorting to sympathectomy, were cured, although no operation was performed. It seems likely that the improvement following sympathectomy was really the result of the spinal anaesthetic used for the operation or for diagnostic purposes. In any case there is now no excuse for performing sympathectomy, but a spinal anaesthetic should be used in place of general anaesthesia when difficulty is experienced in emptying the rectum and pelvic colon by enemas alone.

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Roentgen Study of the Fetus in Utero: Some Practical Considerations[1]

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THE ROENTGEN study of the fetus *in utero* may furnish considerable information which is of practical bearing in the conduct of labor. In our experience with over 2,500 roentgen studies in pregnancy where abnormality was suspected, we have naturally developed a point of view and approach to the study of the fetus which is somewhat different from that of the obstetrician at the bedside or of the pathologist. Such a point of view assumes some importance in view of the fact that the roentgenologist is being called upon for his opinion in such matters.

The roentgen findings that may be obtained regarding the fetus could be grouped as follows:

1. Size and age.
2. Fetal death.
3. Normal and abnormal fetal positions.
4. Extension or deflection of the fetal head.
5. Fetal head engagement.
6. Congenital and acquired diseases.

Fetal Size and Age: When there are sufficient lime deposits in the bones so that the fetus may be visualized *in utero*, it is from twelve to fourteen weeks old. From that time until close to term its age can be estimated by simple inspection of the fetal roentgenogram. We use a lateral view because we depend upon it for location of the placenta and because on it the fetal parts are usually more clearly outlined than on the anteroposterior film, where the maternal spine and intestinal gas shadows may interfere. The size of the image may be influenced by the film-target distance, the size of the mother, and the closeness of the fetus to the film. We try to place the mother for the lateral roentgen view with the fetus near the film. This is more often with the left side down, since left occipito-anterior is the most common position. Sample films of the fetus *in utero* of different ages should be on hand for comparison.

Fig. 1. Overlapping of skull sutures, Spalding's sign of fetal death.

The fetal size and age may also be inferred from the size of the head, the perimeter or the occipito-frontal diameter in particular. Such methods have been developed, especially by Ball, Hodges, Thoms, and Clifford. It has been our practice to find the skull perimeter by first computing the theoretical average diameter after McNeill. The occipito-frontal diameter results parallel those obtained from the perimeter.

[1] Presented before the Radiological Society of North America, at the Twenty-eighth Annual Meeting, Chicago, Ill., Nov. 30–Dec. 4, 1942.

Occipito-Frontal Skull Diameter	Skull Perimeter with Scalp Thickness	Fetal Age	Average Fetal Weight
8.0– 8.5 cm.	20 cm.	25 wk.	1 lb., 1 oz.
9.0– 9.5 cm.	25 cm.	30 wk.	3 lb.
10.5–11.0 cm.	30 cm.	36 wk.	5 lb.
11.0–11.5 cm.	33 cm.	40 wk.	6–7 lb.
11.5–12.0 cm.	34 cm.	40 wk.	7–8 lb.

Like other workers in the field, we have found that estimation of weight when the

Fig. 2. Abdominal pregnancy: fetus lying high and transversely.

fetus is at term, or especially if it is over 7 pounds, is not always dependable. We therefore have been attempting to estimate the weight by a consideration of a number of factors and their correlation.

1. The general size of the fetus as it appears on the film, this being fairly reliable up to term.
2. The size of the bones.
3. The skull perimeter or diameter.
4. The amount of subcutaneous fat evidenced in the fetus. This can be seen best over the breech and is visualized as a black line of demarcation. When the fetus is past due, the fat is usually more abundant. In some cases the fetus appears to be long and thin and shows only a thin layer of subcutaneous fat.
5. The appearance of bony centers of ossification.

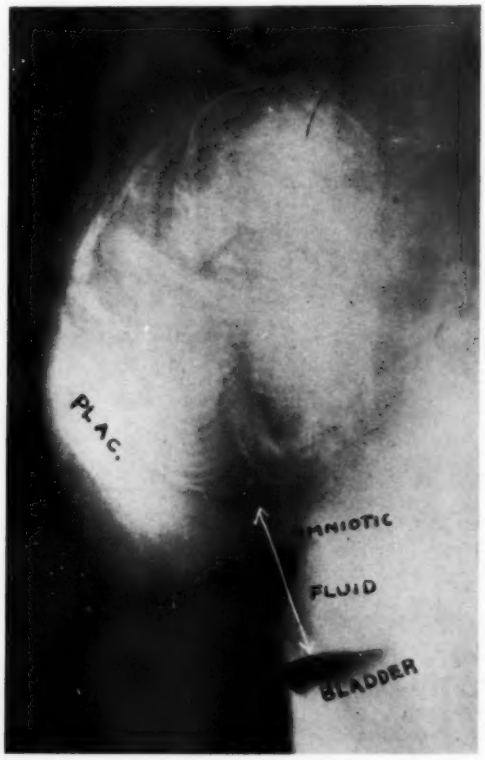

Fig. 3. Hydramnios: fetus transverse. Similar case held by loops of cord twisted firmly about fetus. Checked at section.

Despite the fact that we use these various devices in estimating the fetal weight, we find that we must exercise considerable caution in expressing our results. We would recommend that near term the fetal weight be given as follows, preferably omitting actual numbers:

Small.....5 1/2 to 6 1/2 lb.
Medium.....6 1/2 to 7 1/2 lb.
Large.....Over 8 lb
Very large.....Over 9 lb.

Fetal Death: The roentgen signs of fetal death have been repeatedly and adequately described. The Spalding sign of overlapping of the skull sutures before labor is the earliest evidence of which we know (Fig. 1). In our experience it was first observed four days after the fetal heart stopped. Later, the spine may become abnormally curved and the fetus may assume positions which are obviously abnormal. Still later the fetus may disintegrate or shrink into a lithopedion. It will usually be expelled, however, before this happens.

Fig. 4. Large fibroid located posteriorly in lower uterine segment displacing fetal skull. Section was necessary.

Normal and Abnormal Positions: The normal positions are of interest, particularly at term. They are well recognized and need no review in this report. As has been clearly and ably demonstrated by Torpin, the uterine cavity is wider than it is deep at term. He showed that in over 90 per cent of the cases the placenta is located anteriorly or posteriorly, extending downward from the fundus. His results were obtained by floating the placenta and the amniotic sac, after its extrusion, in a large container of water. Independently, we have arrived at the same conclusion regarding the location of the placenta, as a result of roentgenographic study. Combining the above observations, we find that the general disposition of the fetus in the uterus is more or less such that it lies with its back to the right or to the left of the mother. Since the placenta is in front or in back, the fetus, therefore, half faces it from its left or from its right.

Abnormal positions of the fetus frequently give rise to serious disturbances and are therefore of utmost importance. They may be due to abnormality of the soft parts, such as placenta praevia, the presence of fibroids, abdominal pregnancy (Fig. 2), or hydramnios (Fig. 3). If a fibroid is located posteriorly and below

(Fig. 4), normal delivery is unlikely. If the fibroid is situated anteriorly and below, it frequently rises above the symphysis, permitting delivery from below. Congenital developmental change or death of the fetus may also produce abnormal position in the uterus.

pendulous abdomen; (9) abdominal pregnancy.

Hyperextension or abnormal flexion of the head during labor may be due to some of the above mentioned causes but is most commonly the result of cephalopelvic disproportion or occiput posterior.

Fig. 5. Hyperextension of head. Umbilical cord found around fetal neck as the cause.

Extension or Deflection: A careful consideration of the degree of flexion or deflection of the fetal head may be of practical value, furnishing important information.

Before labor, the head may be normally in military position or slightly flexed or slightly extended.

Hyperextension of the head before labor may be due to any of the following causes: (1) umbilical cord around the fetal neck (Fig. 5); (2) hydramnios; (3) placenta praevia; (4) pelvic masses, such as fibroids or ovarian tumors; (5) distention of the bladder or rectum; (6) twins; (7) large tumor about the neck of the fetus, as thyroid tumor, branchial cyst, or hygroma; (8) occiput anterior and

By elimination, we have been able to diagnose looping of the cord about the neck, with hyperextension. For one such case we are indebted to Dr. U. J. Salmon. It is possible to make this diagnosis on roentgen study because the appearance of hydramnios, placenta praevia, abdominal pregnancy, and pelvic masses is fairly typical; twins are easily excluded; the bladder is emptied before the film studies are made; fecal masses in the colon may be recognized; a pendulous abdomen of the mother is obvious; and tumors of the fetal neck are so rare that for practical purposes they may be disregarded. There are some cases of hyperextension of the fetal head, however, in which the cause is unknown.

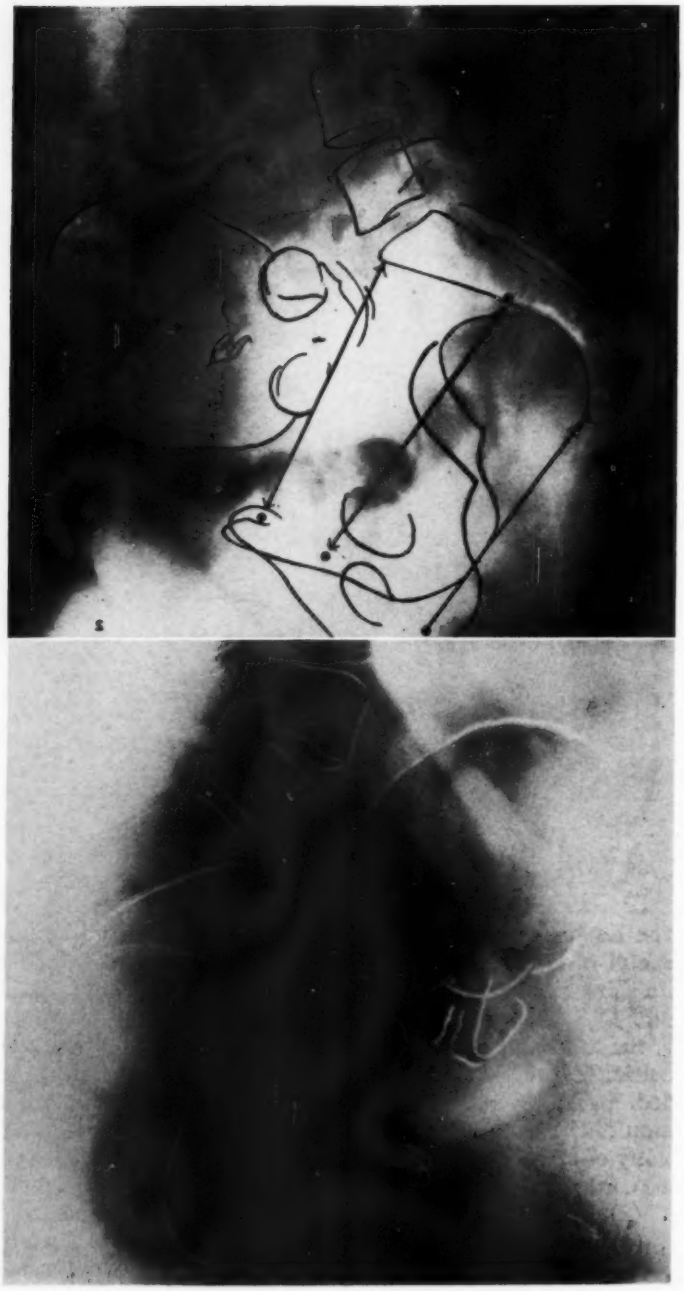

Fig. 6 (above). Posterior face. Delivered by section.
Fig. 7 (below). Anterior face. Spontaneous delivery.

In brow or face presentation, the occurrence of active labor often indicates a marked cephalopelvic disproportion. With a posterior face (Fig. 6), vaginal delivery is rarely possible. With an anterior face, all other conditions being favorable, delivery from below is possible (Fig. 7).

With occiput posterior, the head often maintains a somewhat extended position as it descends into the pelvis until the frontal bones are forced against the symphysis of the mother. Some flexion then develops. The extension is possible because the curve of the sacrum makes room for the occiput (Fig. 8).

Fetal Head Engagement: In this brief paper we cannot go too far into the subject of head engagement. It has been our experience that few cases are sent for roentgen study when the head is well engaged. Once the head has descended well into the pelvis, the likelihood of dystocia is limited to a few possibilities. The conditions mentioned above as producing deflection of the head naturally interfere with fetal head engagement. By far the most common cause, in our experience, has been cephalopelvic disproportion. In a few of our cases, there was no evidence of a disproportion but the head would not engage because of the fact that an arm presented before it.

Congenital and Acquired Diseases: Fetal monstrosities are amazingly varied. The importance of diagnosing these before delivery is evident. Roentgen study is a most reliable aid in this connection. It has been advocated that in every case requiring cesarean section x-ray studies should be made prior to operation to avoid delivery of a monster. One of the most common fetal abnormalities recognized *in utero* is acrania or anencephaly, which is almost always associated with marked hydramnios, the roentgen appearance of which we have described. It consists in geometric soft smooth shadows surrounding the fetus. The fetus also shows a thick layer of subcutaneous fat, evidenced by the broad black line of demarcation.

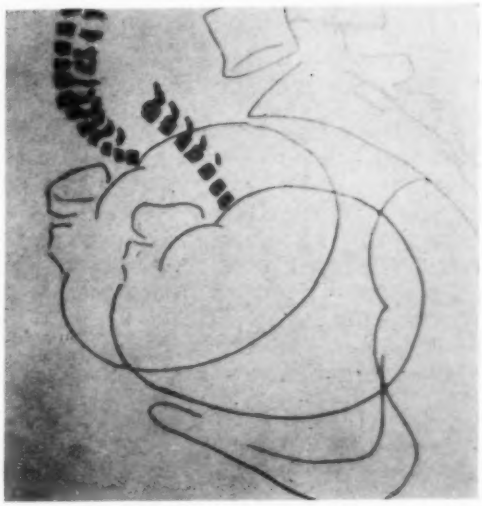

Fig. 8. Occiput posterior. This may normally show poor flexion or even some extension. When the head descends, it flexes as the frontal bones meet the maternal symphysis.

Elephantiasis congenita should be recognizable by the demonstration of extensive fat deposits about the fetus. The roentgen line of demarcation produced by subcutaneous fat is considerably widened.

In symmelus or mermaid there is fusion of the bones of the lower extremities to a greater or lesser degree.

Osteogenesis imperfecta shows extensive deformity of the bones, usually with multiple fractures.

Hydrocephalus is not uncommon. The enormous size of the head is typical.

Premature closure of sutures or unusual thickening of the skull has interfered with molding and caused dystocia in an otherwise favorable case.

Among other fetal conditions that may be recognized are extensive spina bifida, hemivertebrae, supernumerary digits, syphilis, rickets, and fractures.

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Spondylolisthesis: A General Consideration with Emphasis on Radiologic Aspects[1]

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MANY EXCELLENT descriptive and analytical papers have appeared concerning spondylolisthesis since Killian first described it in 1853 and Lovett reported the first traumatic case in 1897. The purpose of this paper is to consider the condition chiefly from the standpoint of diagnosis. If some of the statements are repetitive, the desire for emphasis is responsible.

Spondylolisthesis signifies a displacement of the vertebral column, usually anteriorly, occasionally posteriorly, as the result of a dissolution of continuity or defect of the pars interarticularis of the neural arch of a vertebra. Prespondylolisthesis is the term used to indicate the presence of such a defect, in the sense of a zone of inadequate ossification. This may be unilateral or bilateral and, except in purely traumatic cases, is always the precursor of spondylolisthesis. The essential difference between the two conditions is that, while both present a defect in the posterior neural arch, in spondylolisthesis there is, in addition, *displacement* of the involved vertebra. The term prespondylolisthesis should be limited to those cases which present a demonstrable unilateral or a bilateral defect *without slipping*. It should not be employed to label an obtuse lumbosacral angle or almost horizontal sacrum. Because the shearing forces are unusually great in the region of the 5th lumbar vertebra and 1st sacral segment, such a condition may be a potential spondylolisthesis, but so long as it shows no other change it is neither a spondylolisthesis nor a prespondylolisthesis; it is merely a mechanically bad low back. The designation prespondylolisthesis for this type of case, though sometimes found in the literature, is obviously a misnomer.

Incidence: Various authors have placed the incidence of spondylolisthesis at from 5 to 6 per cent. Fifty per cent of the cases are seen in the third and fourth decades; 76 per cent are in males; 80 per cent occur between the 5th lumbar vertebra and 1st sacral segment, and 50 per cent show Grade I (Meyerding) displacement.

The series of cases to be presented here represents an incidence of over 10 per cent. One hundred and forty-two routine lower spine examinations disclosed 15 cases of prespondylolisthesis or spondylolisthesis.[2] In considering this figure, one must remember that no females were examined; that the average age was twenty-eight years, and that the subjects were all soldiers exposed to many types of hazard. In view of the rather high incidence, and in spite of the fact that this may have been influenced by the age group and particular occupation of the subjects examined, we believe this condition to be much more prevalent than is ordinarily anticipated. In emphasis of this point, we may mention the fact that 4 cases were selected from routine abdominal film studies for urological and gastrointestinal study, not undertaken for examination of the lower back. We believe that diligent search for the defect will reveal it in many unsuspected cases. This contention is borne out by the high incidence in the present series of cases, which were, for the most part, the object of purposeful scrutiny of the lumbosacral area.

Mechanics Involved: That the lumbosacral area presents a large number of confusing anatomical variations is indis-

[1] Accepted for publication in August 1943.

[2] Since this article was submitted, 20 additional cases have been seen, making a total of 35, of which 3 were unilateral prespondylolisthesis, 17 bilateral prespondylolisthesis, and 15 spondylolisthesis.

putable. We shall concern ourselves only with the articular processes of the 5th lumbar vertebra and the 1st sacral segment. As is well known, the plane of articulation of the inferior articular processes of the 5th lumbar vertebra and the superior articular processes of the 1st sacral segment varies considerably. This plane may lie in a sagittal, a coronal, or an oblique direction, or a combination of any of these. Thus, the plane on one side may be sagittal and on the other side coronal or oblique. A wide variety of arrangements are possible and are commonly seen. From the standpoint of stability based on shearing forces, the ideal plane of articulation should be coronal-oblique bilaterally. This would permit rotating motion in all directions and at the same time the superior articular processes of the 1st sacral segment would act as an ample buttress against the forward and downward drive of the inferior articular process of the 5th lumbar vertebra. A bilaterally sagittal plane of articulation should produce, theoretically at least, the weak type of lumbosacral area, since under these conditions the buttress effect would be minimal. The superior articular processes of the 1st sacral segment are in reality mighty props that restrain the tendency of the spine to slip forward. A study of these processes will show them to be solid, thick, and firm in most cases, as they very aptly should be.

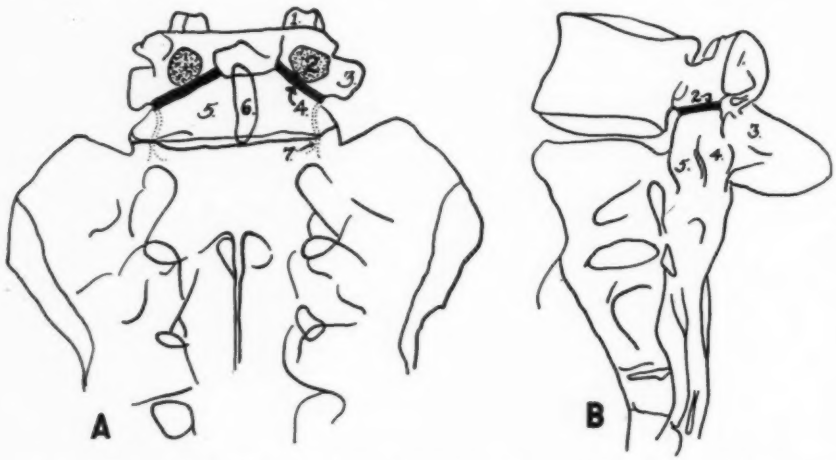

Fig. 1. Anteroposterior and lateral views of specimen with artificially produced defect through pars interarticularis.

A. Anteroposterior view: 1. Superior articular process of 5th lumbar vertebra. 2. Pedicle of 5th lumbar vertebra seen on end. 3. Transverse process of 5th lumbar vertebra. 4. Artificially produced defect through isthmus. 5. Lamina of 5th lumbar vertebra. 6. Spinous process of 5th lumbar vertebra. 7. Articular process of 5th lumbar vertebra and 1st sacral segment.

B. Lateral view: 1. Superior articular process of 5th lumbar vertebra. 2. Artificially produced defect through isthmus. 3. Spinous process of 5th lumbar vertebra. 4. Inferior articular process of 5th lumbar vertebra. 5. Superior articular process of 1st sacral segment.

The lumbosacral angle is another important factor in a consideration of stability of the lower spine. The normal angle is approximately 42 to 45 degrees; the more obtuse this angle the more horizontal the sacrum and the less supportive effect afforded by the superior articular surface of the sacrum with reference to the spine above. In other words, the greater the angle the less stability at the lumbosacral area.

Additional support is rendered the lower back in this region by the anterior longitudinal ligaments, which, however, are not particularly effective, being comparatively thin structures. The iliolumbar, the sacro-

iliac, and the interspinous ligaments act as strong supporting agents and in the presence of a defect in the posterior neural arch these structures are called upon to exert their greatest effort to keep the lower lumbar spine in place with respect to the first sacral segment. At best, however, the lumbosacral joint must be considered an unstable mechanism. It is a junction of a mobile and immobile part. It represents an area of phylogenetic shortening consequent to change in posture from the horizontal to the erect. It is the site of a rotating type of action, which is often based on asymmetrically placed facets, and is always subject to tremendous shearing strain.

Pathology and Anatomy: The 5th lumbar vertebra is too well known a structure to require a detailed anatomical description. One may recall, however, that the posterior neural arch is really an osseous ring bounded anteriorly by the posterior surface of the body of the vertebra, laterally by the pedicles, posterolaterally by the superior and inferior processes, and posteriorly by the laminae and spinous process. That portion of the posterior neural arch which lies between the superior and inferior articular processes and just behind and below the posterior portion of the pedicles is known as the pars interarticularis, isthmic zone, or isthmus. It is with this particular region that we are

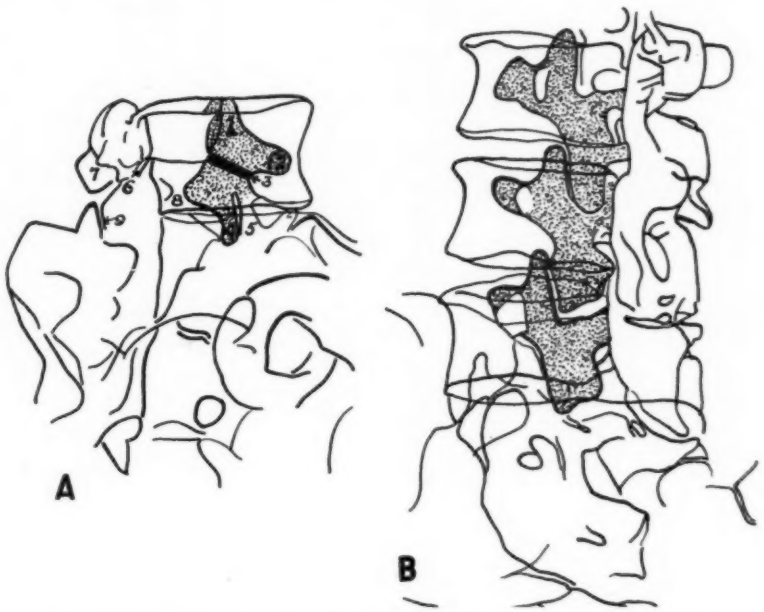

Fig. 2. Oblique views of specimen with artificially produced defect through pars interarticularis.

A. Dotted areas represent typical "bow-tie." Dark heavy line represents site of artificially produced defect. 1. Superior articular process of 5th lumbar vertebra. 2. Tip of transverse process superimposed on superior articular process. 3. Defect through pars interarticularis. 4. Inferior articular process of 5th lumbar vertebra. 5. Superior articular process of 1st sacral segment. 6. Joint space between superior and inferior articular process of 5th lumbar vertebra and 1st sacral segment. 7. Spinous process of 5th lumbar vertebra. 8. Lamina of 5th lumbar vertebra. 9. Joint space between inferior articular process of 5th lumbar vertebra and superior articular process of 1st sacral segment, opposite side.

B. Dotted areas represent "bow-tie." Light areas within dotted areas represent tips of transverse processes seen on end.

TABLE I: FIFTEEN CASES OF SPONDYLOLISTHESIS AND PRESPONDYLOLISTHESIS

Case	Age (years)	History of Injury	X-ray Findings	Neurological Symptoms	Subjective Symptoms	Objective Symptoms	Duration of Symptoms
1	28	None. Fit of violent coughing (5/3/43) and severe back pain	Spondylolisthesis, 1st Grade	None	Pain in lower back; no radiation	Loss of lumbar lordosis	Backaches since 1936
2	33	Auto accident 6/7/41	Spondylolisthesis, 1st Grade	None	Knife-like pain in lower back, aggravated by bending; sciatica	None	2 years
3	19	None. Cold with cough Nov. 1942. Pain in right hip on coughing	Prespondylolisthesis, bilateral	None	Pain so severe patient could not bear weight on right hip	Symmetrical atrophy, both legs	6 months
4	27	Injured playing football, 1934	Prespondylolisthesis, bilateral	None	Pain in lower back, right buttock, right leg	Tenderness over 1st sacral segment. Loss of lumbar lordosis, spasm of lumbar muscles with limitation of motion	9 years
5	42	Fracture of 2nd lumbar vertebra, auto accident	Spondylolisthesis, 1st Grade Fracture 2nd lumbar	None	Pain in lower back, worse last 8 months	Spine immobile. Decreased lumbar lordosis. Muscle spasm. Limitation of motion	2½ years
6	21	Thrown from horse, 1941	Prespondylolisthesis, unilateral, right side	None	Low back pain; some radiation to rt. thigh	Moderate tenderness over 1st sacral area	18 months
7	42	None	Prespondylolisthesis	None	Arthritis, non-suppurative, left foot	Increased sed. rate. Limited flexion and extension, left hip	?
8	24	No history	Spondylolisthesis	None	No history	No history	No history
9	24	Caught under overturned half truck 9/14/41; also fall down steps 2/24/43	Unilateral prespondylolisthesis	None	Low back pain; no radiation	Lumbar 4 a little prominent. Moderate tenderness to right of lumbar 5. Discomfort on hyperextension and hyperflexion	3 months
10	22	None. Condition seen on colon films	Spondylolisthesis, 1st Grade	None	None	None	None
11	28	Fell on back in 1938; almost paralyzed both legs. No x-rays	Reverse spondylolisthesis	None	Pain in lower back radiating to right hip. Relief on rest in bed	Slight kyphosis, lower lumbar	1 week. On working 3 months later, pain recurred
12	33	Pain in back after ride in jeep (5/10/43). Fractured 2nd lumbar, probably old. Football injury in 1930. No x-rays then	Reverse spondylolisthesis	None	Low back pain, worse when standing or bending; radiation to left hip and thigh	Slight tenderness over left sacroiliac. Motion increases pain	13 years
13	22	Defect noted in review of films taken elsewhere	Prespondylolisthesis, bilateral	Area of anesthesia over lower back and entire left leg, without organic basis	None	None	None
14	35	Defect noted on genito-urinary films	Prespondylolisthesis, bilateral	None	None	None	None
15	27	Defect noted on gastro-intestinal films	Prespondylolisthesis, bilateral	Lower reflexes markedly exaggerated	Lower backache	None	3 years

concerned. Here is found the defect or dissolution of continuity of the posterior neural arch which occurs in prespondylolisthesis and spondylolisthesis. Instead of a solid core of bone being present, as occurs normally, there is a connecting zone of cartilage or cartilage plus a thin core of bone. The plane of this break is usually slightly oblique, with the middle portion directed slightly upward and the lateral portion slightly downward. The defect may, however, be transverse. We have never seen it occur in any other plane than the two above cited. This defect, or break, may be unilateral or bilateral. Naturally, bilaterality means much greater weakness at these points, since a unilateral defect leaves one sound pars interarticularis for support. When the defect is bilateral, the body of the vertebra must of necessity, if subjected to sufficient strain, lose its anchor to the pelvis. That portion of the neural arch anterior to the defect, namely the body of the vertebra, the pedicles, and the superior articular processes, is separated from the inferior articular processes which originally were an integral part of the vertebra involved. Left behind are those parts of the vertebra posterior to the defect, namely the inferior articular processes, the laminae, and the spinous process. These latter structures remain in juxtaposition and in normal relationship to the superior articular processes of the vertebra below.

Pheasant and Swenson (2) found only two cases of unfused neural arches in 171 spines dissected for study of the lumbosacral region. Protrusion or herniation of the disk is rarely associated with this condition except where we are dealing with a severe grade of spondylolisthesis. Occasionally the intervertebral disk may show some thinning. Müller's case of congenital absence of the inferior articular processes of the 2nd lumbar vertebra without resulting spondylolisthesis is of interest. That anterior or posterior displacement did not occur is probably to be explained by the fact that the upper lumbar spine does not present the obliquity characteristic of the area of the 5th lumbar vertebra; also that the 2nd lumbar vertebra rests flatly and securely on the 3rd lumbar, so that this region is subject to less shearing strain.

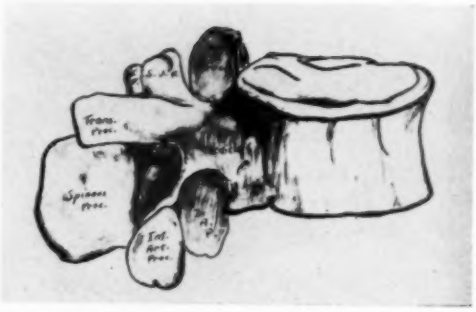

Fig. 3. Sketch of normal 5th lumbar vertebra, showing in particular the superior and inferior articular processes, the pedicles, and the isthmus.

The paravertebral soft tissue structures of the area are then called upon for added support and as a result stretch and thicken. If the soft tissue structures, namely the surrounding ligaments, are equal to this added task and the lumbosacral angle is within normal limits so that shearing strains can be minimized and there is no superimposed sudden or even gradual traumatic effect, there will be no forward slipping of the spine. The circumstances incidental to the individual case will decide whether or not slipping is to occur. Suffice it to say that the existence of this defect, even though it be unilateral, presents the picture of prespondylolisthesis prior to slipping. When slipping has occurred, we pass on to the phase of spondylolisthesis. After the spondylolisthesis develops, if the degree of forward displacement is sufficient, the intervertebral disk may be dislocated and undergo progressive degeneration. Thus nature attempts to utilize the dislocated disk as a buttress to prevent, by calcification and ossification, further progression of the slipping.

Meyerding (3) conveniently divides the articular surface of the sacrum into four transverse planes, the first traversing the posterior fourth and the last the anterior fourth of the articular surface. If the

Fig. 4. Roentgenograms of model sacrum and 5th lumbar vertebra before (bottom row) and after defect was artificially produced (top row). Conventional lateral, anteroposterior, and oblique views shown in the order mentioned. Lead numerals were used to identify various structures.

postero-inferior angle of the anteriorly displaced vertebra lies within this posterior or first segment, the displacement is referred to as a Grade I spondylolisthesis. If it lies in the third segment, the case is one of Grade III spondylolisthesis, and so on. As Meyerding further suggests, an injury during birth or shortly after may produce a bone infarct with consequent softening and later a picture strongly suggestive of osteochondritis. We have found that the appearance of some of the isthmic zones tends to corroborate this possibility, as we have noted fragmentation with increased density of the fragments.

Genesis: With respect to the genesis of spondylolisthesis there is considerable difference of opinion. Most of the earlier workers have based their interpretation of this defect upon the presence of five

centers of ossification; one for the body and two for each lateral mass. Willis (4) accepted this view and went on to claim that of the two lateral masses one forms the pedicle and superior articular facet, while the other is concerned with the ossification of the lamina and inferior articular facet. If failure of these two structures to unite occurs, a defect is produced with consequent separation of the body from the posterior neural arch. Neugebauer was of the same opinion but attributed most cases to injury. George (5) believes the defect to be developmental in origin. He mentions two patients with typical spondylolisthesis who married and had two children. One of the latter, now twenty-one years of age, shows an incomplete sacralization of the 5th lumbar vertebra and the other shows a prespondylolisthesis of the 5th lumbar vertebra. No one has been able to produce evidence that inflammation is an etiological agent, although Killian believed the process to represent a caries.

In favor of a congenital origin the argument has been advanced that at the time of operation no callus is found. Furthermore, the literature does not show one case of spondylolisthesis following trauma in which earlier films revealed a perfectly normal spine. It is also argued that, since 25 per cent of the cases are unilateral, fracture or injury cannot be the cause. The fact that associated developmental defects may be found is another argument advanced as favoring a congenital origin. George (5) in a series of 3,301 patients seen at the New York Orthopedic Dispensary and Hospital with signs and symptoms referable to the spine found the incidence of spondylolisthesis and prespondylolisthesis to be 3.5 per cent. He believes that this figure in comparison with other reported figures would suggest that neural arch defects occur in many instances without producing symptoms. Willis (4) admits that the fact that defects exist without symptoms, and that symptoms usually follow trauma, would indicate that the defects are predisposing rather than direct etiological factors. He holds that the absence of any obvious attempt at union would tend to rule out fracture as a cause.

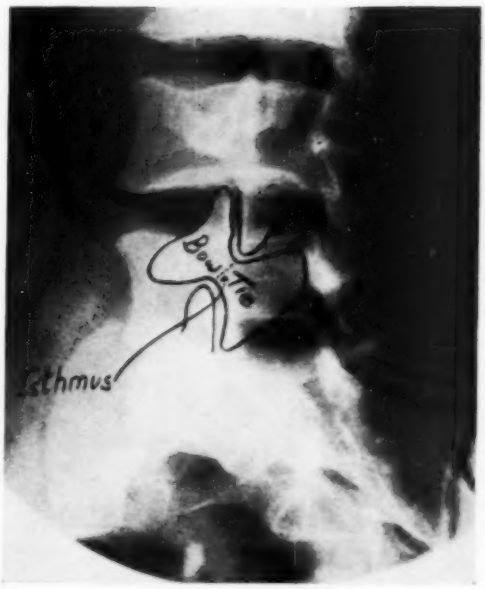

Fig. 5. Normal oblique view for purpose of demonstrating "bow-tie" appearance of the combination of the following structures of the 5th lumbar vertebra: superior articular process, inferior articular process, and connecting portion, the isthmus. The relationship of both the superior and inferior articular processes to the articular processes of the 4th lumbar vertebra above and the 1st sacral segment below, is also indicated. Parts sketched in for demonstration purposes.

Hitchcock (6) states that the work of Rambaud and Renault, who described the existence of five centers of ossification for each vertebra, has not been substantiated. Batts (7) challenges the congenital theory by stating that, if the separated neural arch occurs in 5 per cent of fully developed skeletons, it should also be found in approximately 5 per cent of fetal or newborn skeletons. He believes that there are three centers of ossification—not five—and that the centers for the posterior neural arch fuse at term or shortly thereafter. Failure of fusion results in spina bifida. The neural arch becomes fused with the body of the vertebra from the fourth to the sixth year. Mall, Willis, and Chandler were unable to find any evidence of double or anomalous centers of ossification in a series of 200

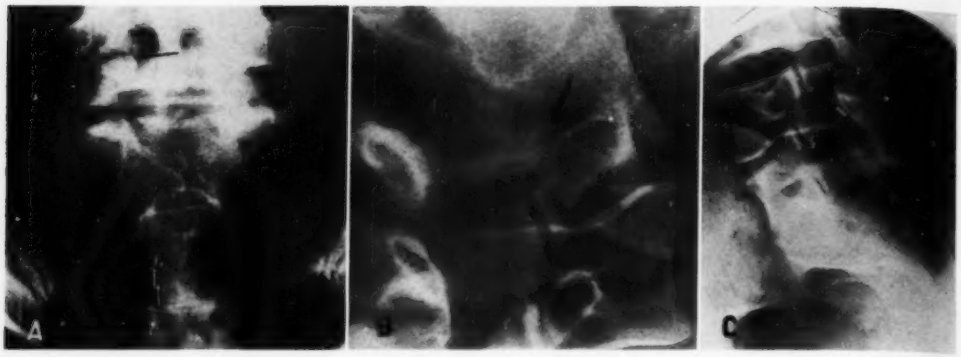

Fig. 6. Unilateral prespondylolisthesis.

A. Anteroposterior view showing linear defect (arrow) on right side. Note that the defect line is immediately below the pedicle seen on end and that its medial portion is slightly higher than its lateral portion. Note absence of similar line on contralateral side.
B. Right oblique view, indicating site of defect.
C. Left oblique view, showing normal isthmus on left side.

fetal spines, ranging in age from three months to term. Meyerding believes that trauma is the exciting cause but that underlying it in most instances is a defect, so that injury may be considered the principal etiological factor and a congenital lesion the anatomical or predisposing factor. Chandler (8) quotes Hibbs and Swift as reporting a history of injury in 49 per cent of 23 cases. He makes a very pointed criticism of roentgenologists for not insisting on good films which will reveal the details of all bony structures at the lumbosacral junction. He further questions the peculiar coincidence of the site of "congenital clefts" and the point of maximum shearing strain of the isthmus and suggests the possibility that some of these "clefts" may in reality be fractures sustained during early childhood. Brailsford (9) cites as many as 23 workers who differ as to the etiological agent of this condition. He is of the opinion that pregnancy does not influence or predispose to the development of spondylolisthesis.

The author believes that the work of Hitchcock and his explanations of his findings must be considered seriously. His observations, based on a study of 90 human fetuses ranging in age from six weeks intrauterine life to term, show that each vertebra ossifies from three centers. Ossification of each half of the neural arch commences at the base of the articular process close to the isthmus. The laminae are formed a little ahead of the pedicles. A double or defective center was never found. Hitchcock goes on to describe the isthmic region as remaining cartilaginous up to and after birth. He also raises the question as to why, if the defect is congenital and has been found to exist in 5 per cent of 2,000 cases, one cannot find even one anomalous or defective center of ossification in fetal material. One must assume that the defect is *not* congenital, although most orthopedists hold it to be. He further states that the isthmic area is occupied by blood vessels almost sinusoidal in character, which weaken this particular region.

Hitchcock experimented with stillborn infants ranging from eight months to term and cadavers up to ten months postnatal. He found that moderate hyperflexion readily fractured the neural arch in the lower lumbar region. Most of the fractures were bilateral, but he was able to produce unilateral fractures by combining flexion with lateral bending and some torsion. Flexion, as he points out, is more limited in extent (12° from the perpendicular) than extension (25° from the perpendicular). Attempts at hyperextension failed to produce fracture, but forced

hyperextension resulted in tearing of the anterior longitudinal ligaments and separation of the vertebral bodies. The conclusion is reached that in hyperflexion the anterior margins of the vertebra act as a fulcrum. Hitchcock's findings serve to strengthen the traumatic theory of the origin of spondylolisthesis. According to his theory, flexion applied during delivery or shortly after birth, for resuscitation or stimulation, may produce fracture, with

Fig. 7. Anteroposterior views of two cases, showing location and roentgenographic appearance of defect.

subsequent union by fibrous tissue or cartilage and the development of a pseudarthrosis.

Symptoms: Many cases (10 per cent) of unilateral and even bilateral spondylolisthesis are asymptomatic, the lesion being found accidentally. This was so in 4 of the cases here presented. In other instances there may be complaint of low back pain, weakness, fatigue, or stiffness in the lower back. The pain may be localized in the low back or radiate to the hip, buttocks, coccyx, and even down the leg or along the course of the sciatic nerve. Meyerding (3) states that backache was the chief complaint of more than 80 per cent of 583 patients. Relief of backache

Fig. 8. Anteroposterior and lateral views showing defect. This is particularly well shown in the lateral view (arrow).

by rest in the recumbent position is a fairly common finding. Kleinberg (10) states that sudden muscle strain may result in edema and hemorrhage at the site of the defect, causing pressure on the sciatic nerve, producing a sciatic syndrome. He further states that lordosis is usually present. We found several instances of loss of normal lordotic curvature in the low lumbar spine area. This is, however, only an apparent loss and is due to the fact that the sacrum appears to lie more posteriorly and the normal lordotic curvature is shifted slightly cephalad. Local pressure and motion aggravate the pain, and spasm of muscles tends to resist movement and therefore results in limitation of motion. In bilateral lesions one may find acute tenderness over the spinous process and in advanced cases this may occasionally be moved from side to side. This is certainly the experience of orthopedic men who have come upon a bilateral defect at the operating table. A prominent spinous process of the 5th lumbar vertebra is often present.

Neurological examination is usually nega-

tive. It is a common experience to have a patient complain of low back pain following injury, either single or multiple, often trivial in nature. In such cases trauma is definitely an exciting factor which probably aggravates a pre-existing condition, such as prespondylolisthesis. Spondylolisthesis *per se*, if of minimal grade or degree, may occasionally be asymptomatic, but most patients will have definite complaints referable to the low back, as described above.

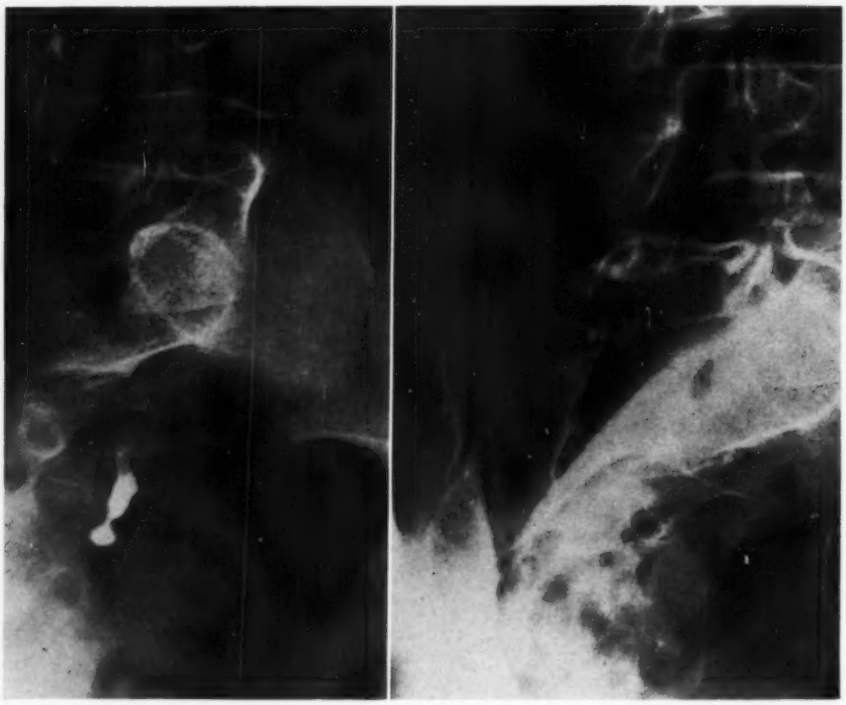

Fig. 9. Left and right oblique views, demonstrating a dissolution of continuity in the isthmic portions bilaterally. Superior articular process of 1st sacral segment is seen jutting into the area of dissolution (isthmic area).

Diagnosis: Neugebauer aptly states that "it lies with anatomists and pathological anatomists and those who make surgical and forensic postmortems, to look out for the early stages of spondylolisthesis and all cases of injury from falls." The roentgenologist must definitely be included in the group charged with discovering the early stages of this condition. With improved technical methods for a complete study of the lumbosacral spine and a thorough knowledge and comprehension of the anatomy of the region and of the defect involved, most cases should be discovered. Films of good technical quality, particularly lateral views of the lumbosacral area and the right and left oblique views, are extremely important. We have found that the defect may be obvious in some views and not in others. Case, working on a model of the pelvis embedded in paraffin, showed that unless the central ray is directed over the defect it will not be demonstrated. This probably accounts for occasional failures.

Our method of routine study of the lumbosacral area includes the following views: anteroposterior; direct and accurate lateral; right and left anteroposterior oblique; lumbosacral angle view (45° tilt).

In the anteroposterior view the defect appears as a dissolution of continuity lying just below the circular shadow produced by the pedicles seen on end. In this view the line of defect is slightly higher medially than laterally—a difference of a few millimeters. The lateral limitation of the line of defect is usually just below the attachment of the transverse process to the body. Occasionally the line of defect is horizontal. It is seldom a complete straight line; usually it is irregular, measuring about 1 mm. or slightly more in width. This defect may be unilateral or bilateral. It may exist and not be apparent on an anteroposterior film unless the central ray is aimed directly through the plane of the defect. Occasionally the lumbosacral space (angle) view reveals a defect which is not seen in the anteroposterior view.

The right and left oblique views are extremely important for diagnosis, for it is seldom that, given a film of good technical quality in a case in which the defect exists, it cannot be demonstrated. We like to refer to the superior articular process, the pars interarticularis, and the inferior articular process of any one lumbar vertebra as presenting, in either oblique view, a so-called "bow-tie" appearance. The superior and inferior articular processes constitute the lateral portions or the wings of the "bow-tie," while the pars interarticularis, or isthmus, is represented by the central or constricted portion. This is a constant appearance in both oblique views. The "bow-tie" usually extends from the upper portion of the middle third of the body of the involved vertebra downward and backward to the isthmic zone and from this point more directly downward and less directly posteriorly. The inferior portion crosses the posterior third of the intervertebral space between the lumbar vertebra to which the "bow-tie" belongs and the next lower lumbar vertebra. In the right oblique view the "bow-tie" pattern, representing the right superior and inferior articular processes, will lie posteriorly, well behind and below the body and intervertebral foramina. In this view the spinous process of the lumbar vertebra is the most posterior structure. In the left oblique view, the left superior and inferior articular processes will occupy the position described above; namely, traversing the middle and posterior thirds of the lumbar vertebra, while the right superior and inferior articular processes will lie posteriorly. It is understood that slight rotation of a few degrees, anteriorly or posteriorly, of the lumbar spine will result in throwing the "bow-tie" slightly anteriorly or posteriorly, depending on whether the degree of obliquity is greater or less. A study of the film depicting the 5th lumbar vertebra and sacrum with the artificially induced defect of the pars interarticularis will serve to clarify the location of the various structures. It is the oblique view which best reveals the isthmic zone or pars interarticularis.

Fig. 10. Oblique view, demonstrating typical defect in isthmic portion, with fragmentation and sclerosis. This type of roentgenogram makes one wonder as to the possibility that osteochondritis may play a part in this entity.

For the lateral view it is important that

the patient lie exactly perpendicular to the plane of the film. Here the defect will be seen as a more or less horizontal or slightly tilted straight line traversing the pars interarticularis, and lying below and behind the pedicle of the vertebra involved. The upper posterior angle of the intervertebral foramen lying between the involved vertebra and the vertebra below will mark the anterior limit of this straight line. From this point the defect can be followed posteriorly. It is essential, as previously noted, that lateral films be of good technical quality. Coning and immobilization of the patient are of great help. We concede that a lateral view taken in the erect position, as well as one in the recumbent position, may occasionally be of assistance in demonstrating further slipping. A good lateral recumbent film, however, is generally considered sufficient. If the defect is unilateral, say limited to the right side, and a left lateral view is taken, it is understandable why the line of defect will not be clearly demonstrated. In these cases it is desirable to take both a right and a left lateral view.

We wish to emphasize that inconsistency in demonstration of the defect in the various views, that is to say, ability to demonstrate it in one view and not in others, should not cast doubt upon its existence, but is to be explained on the basis of failure of the direct central ray to catch the plane of the lesion. The complex structure of the region involved, plus the frequent occurrence of anatomical variations, renders it almost impossible invariably to traverse the defect so that it can be demonstrated. This is one reason why multiple views are strongly recommended. The lumbosacral angle view, taken with the central ray directed 45 degrees cephalad and emerging through the lumbosacral space, is occasionally of value, since in this view the inferior articular processes

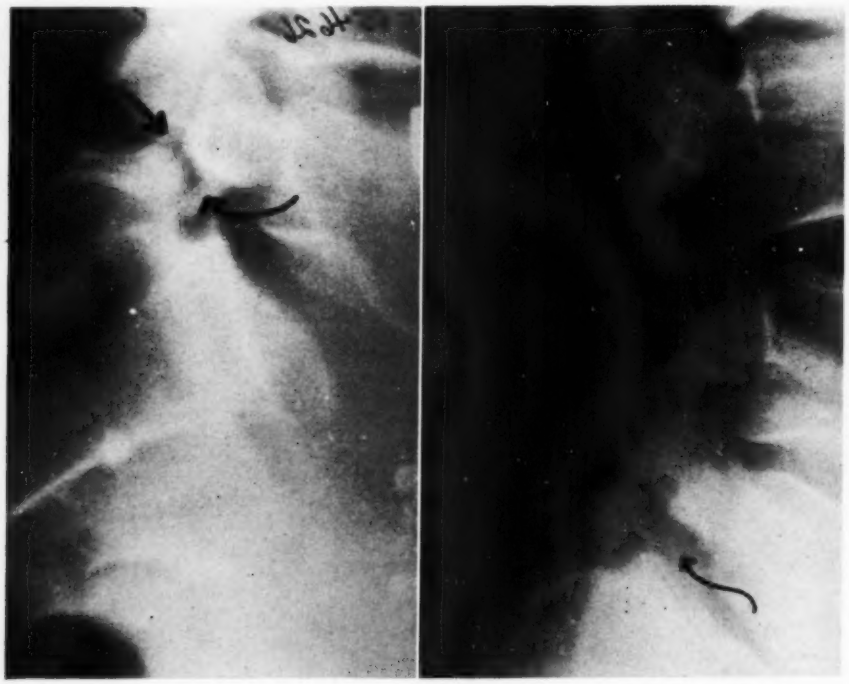

Fig. 11. Lateral views of 2 cases, revealing defect below and behind the postero-inferior angle of the pedicle.

may be seen through the intervertebral space. In this way the superimposition of the body is sometimes avoided. This view is also of some assistance in those cases in which the articular space between the facets may simulate a defect, particularly if the plane of articulation lies in a coronal-oblique direction. In the lumbosacral view the plane of articulation between the superior and inferior facets will come to lie within the intervertebral space or fairly close to it, so that it is more clearly demonstrated. This is an important point to remember, namely that one must not confuse the joint space between the two articulating processes with a defect when the latter is being sought.

It is our opinion that the most important views are the anteroposterior, the right and left oblique, and the true lateral. It cannot be too strongly emphasized that films of excellent technical quality are of paramount importance, as this defect is very often elusive and difficult to demonstrate. The above description of the various views, while necessary, can almost be discarded if one has access to a model of the lower lumbar spine and sacrum and becomes thoroughly familiar with all the structures involved, and knows how and where they will appear on the film in the various positions mentioned. We have described the defect and its exact location and extent to some length because we feel that a thorough knowledge of these matters will help reveal numerous cases of prespondylolisthesis which are unsuspected and which, in our opinion, if the defect is bilateral, will ultimately go on to spondylolisthesis with its characteristic crippling effects. We strongly urge that all films of the abdomen for purposes other than spine study receive the attention of the roentgenologist with reference to the 4th and 5th lumbar vertebrae, and that a search be made beneath the pedicles for a defect line.

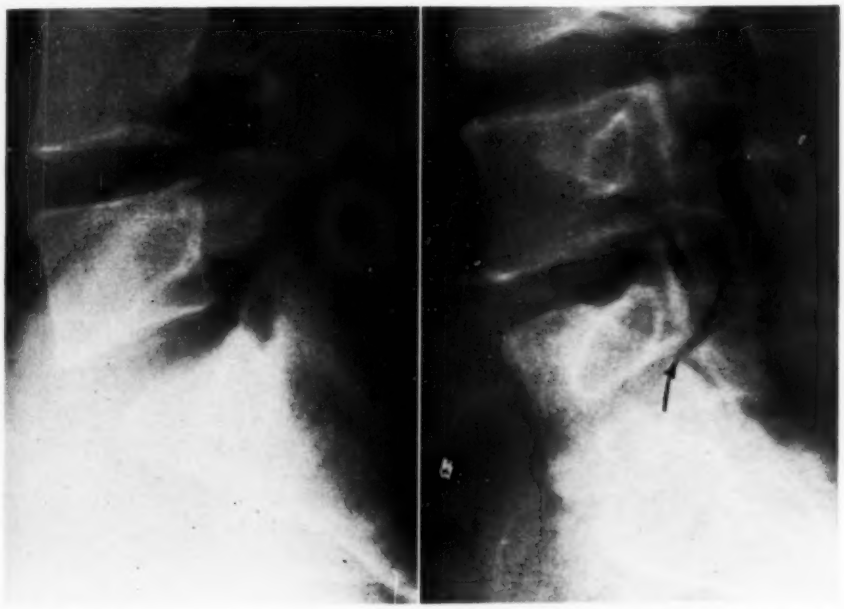

Fig. 12 (left). Lateral view showing definite linear defect below and behind the pedicles of the 5th lumbar vertebra. The width of such a defect may vary from 1 to several millimeters.
Fig. 13 (right). Oblique view demonstrating typical defect, in this case a smooth one, through the isthmic portion of the "bow-tie" area.

Brailsford (9) refers to a "bowline" as

Fig. 14. Anteroposterior view which reveals bilateral defects beneath the on-end shadows of the pedicles. Note that the medial ends of the defect lines lie more cephalad than the lateral extremities of these lines. The lower arrow indicates site of apophyseal joint space. This may occasionally offer difficulty in differentiation but if it is remembered that the medial portion of a true defect line is always higher in relationship to its lateral portion, the differentiation should be fairly easy in most cases.

being characteristic of spondylolisthesis. This is present fairly often in the anteroposterior view and represents a converging of the inferior and lateral aspects of the slipped 5th lumbar vertebra with the inferior and lateral aspects of the transverse processes of this vertebra. Since most of our cases were either prespondylolisthesis or first-grade spondylolisthesis, we were unable to demonstrate this characteristic appearance. We have seen it, however, in more advanced cases and it may be considered of value in the diagnosis of this condition.

Differential Diagnosis: We are of the opinion that accurate, painstaking examination of the lumbosacral area in the positions above outlined, with films of good technical quality, will leave little difficulty in distinguishing this lesion from other possibilities. Fracture dislocations, Kümmell's disease (an entity of which we have some doubt), Pott's disease, malignant neoplasm, congenital dislocation of the hip, and osteomalacia are occasionally to be considered as diagnostic possibilities. Whether due to misguided confidence or sheer good fortune, we have not had to consider too seriously any of these before arriving at a definite diagnosis of spondylolisthesis.

At this writing, 2 of our 5 cases of spondylolisthesis have been verified at operation. Spine fusions were done.

Treatment: Treatment, we feel, belongs to the realm of the orthopedist. For purposes of completeness, however, we may say that spine fusion is considered adequate and curative treatment for frank spondylolisthesis. We need not enter into a discussion of the various types of fusion. It is interesting to note that an English orthopedist describes a method of obtaining reduction of a forward displacement of the 5th lumbar vertebra by suspending the patient on a sling around the pelvis, with another sling placed below the shoulders, plus traction on the legs. He reproduces roentgenograms to show the reduction obtained by such a method. Conservative treatment, such as frequent physiotherapy, postural exercises to reduce lumbar lordosis, use of a firm bed, and support with a belt, will be followed by symptomatic relief in about one-third of the cases.

SUMMARY

The terms prespondylolisthesis and spondylolisthesis are defined and differentiated. In the former, we have the presence of a defect in the neural arch. In the latter, we find separation at the site of defect and slipping of the lumbar vertebra involved. An unusually high rate of incidence—10 per cent—is represented by the relatively small series of cases recorded here. Over 50 per cent of the cases were prespondylolisthesis, 4 of these being discovered in films not intended for spine study. One explanation of the high incidence is

the fact that soldiers constitute an age group characteristic of this condition and are subject to unusual hazards and strains. The natural weakness of the lumbosacral area is definitely exaggerated by any superimposed weakness, such as the defect here described.

The cause of the defect in the posterior neural arch, specifically in the pars interarticularis area, is not definitely proved. One group considers it congenital and another the result of trauma. We are inclined to concur with the opinion expressed by Hitchcock (6), namely, that there is a strong possibility that the defect is not congenital, but rather traumatic in origin.

Symptoms may be present and may be fairly characteristic, but the diagnosis can seldom be made from the clinical picture alone. Roentgenograms are essential to the conclusive diagnosis. It is for this reason that we have described and illustrated in some detail the location and character of the defect. We believe that its discovery is of great importance in both civilian and military life, since its presence means a weak link in a not overly strong chain. Certainly with unusual and often with ordinary strains and hazards, separation may develop, and from this point it is a short step to actual forward slipping of the vertebra. The literature is replete with cases demonstrating the progressive character of this slipping action with eventual frank spondylolisthesis. The crippling nature of this latter condition must be at once apparent. If the lesion is detected early, precautionary measures may be directed toward prevention of its further progress. Apropos of this, however, one observer mentions progressive forward slipping in spite of a supporting belt and avoidance of strain.

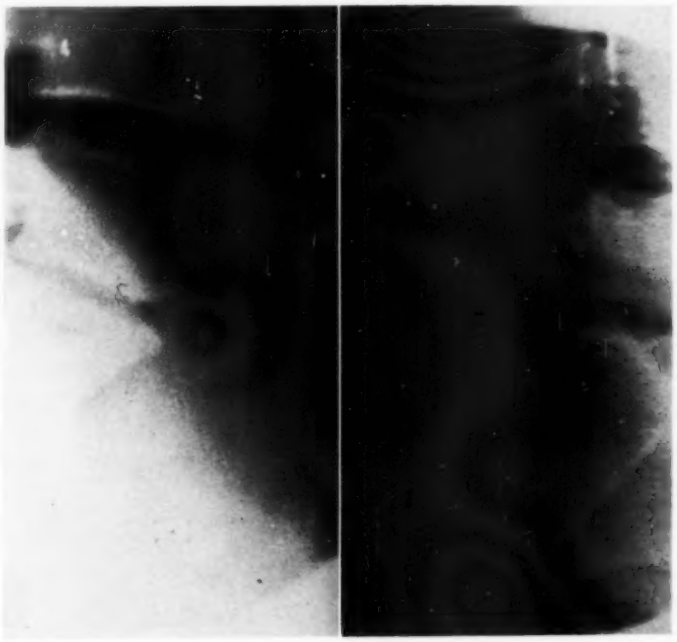

Fig. 15. Two cases of posterior or reverse spondylolisthesis of 5th lumbar vertebra on 1st sacral segment.

Films of good technical quality, particularly oblique and lateral views, are essential. Demonstration of the "bow-tie" area in the oblique view is necessary if

the site of the lesion or defect is to be apparent. We wish once again to emphasize the importance of constantly looking for this condition in both civilian and military life, the progressive character of the disease, and its possible medicolegal importance.

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Castration in Malignant and Non-Malignant Disease[1]

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IT APPEARS THAT sex hormone production is reduced or inhibited after irradiation castration and following surgical ablation of ovaries or testicles. When the growth-stimulating influences of sex hormones are withdrawn, clinical observations show definite alterations of certain pathological conditions. There also follow certain histological and physiological changes which influence the general state of health and may be concerned with both the origin and the progress of malignant disease.

Human castration of the male by orchiectomy, creating defective masculinity, has been practised from remote antiquity by some Orientals. Historical records indicate that great numbers of eunuchs were created in ancient Egypt, Greece, and other countries both for religious and secular purposes. In fact, the demand for the high-pitched falsetto voice in a man singing in religious ceremonies has been abandoned only within recent years. When the earliest records were compiled, it was recognized that not only was fertility terminated by castration, but that certain other abnormal changes ensued, affecting growth and mental development.

Recent medical research has explained some of the phenomena of castration and it is my purpose to call attention to a few of the phases which concern us in the control of disease.

Castration may be performed in the human being (15, 16) for two purposes: first, to halt fertility; second, to induce specific changes, particularly in the endocrine system. Two methods are employed, the surgical and the radiological. In surgical castration it is intended that the entire influence of the testicle or ovary be terminated by complete ablation of the organ, while in radiological castration certain components of usefulness may be retained while those whose elimination is essential to accomplish the desired purpose are destroyed.

Two classes of disease will be considered —malignant and non-malignant—both of which are in some way influenced by the activity of the sex organs. One of the most essential objects of castration is to modify the action of the growth-stimulating hormones—estrone in the female and androsterone in the male. The true role played by these important hormones in physiological processes essential to the proper development and maintenance of health is rapidly being elucidated through experimental investigations on animals and in clinical research.

Changes, both objective and subjective, appearing in the breasts with menstruation have long been recognized and studied. These have taken on a new significance since Rosenburg (1) discovered and interpreted the mechanism of the sex cycle in the breast. Ingleby (2) writes: "The sex cycle in the breast was discovered by Rosenburg in 1922. A revolution in the interpretation of pathological lesions followed. Proliferation of glandular elements during the premenstrual phase is far more rapid than the growth of any carcinoma. Their postmenstrual regression is equally astonishing—for after a few days only traces of former lobules remain in the form of one or two clefts barely visible in the connective tissue which has closed in and obliterated the site of the glandular mass." After castration, as also following the natural menopause, this periodical and phenomenal proliferative and regressive tissue change ceases and the other phases of the climacterium ensue.

That the ovarian hormones exercise a definite influence on the histologic and

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physiologic character of the breasts during the sex life of the individual has been accepted without question. It is not so clear, however, just what can be accomplished at present by modifying these conditions through castration.

In the male, castration exerts an influence upon the prostate that is somewhat comparable to that on the breasts in the female, for it seems that the physiological growth variations in both are to be explained on a hormonal basis. While it is not certain that a definite cyclic proliferation of prostatic epithelium occurs, true hypertrophy is observed in a high percentage of males in later life when testicular function has not been reduced. If testicular function is lost, then hypertrophy does not proceed in the regular way.

The male sex hormone—androsterone—is known to stimulate growth of the prostatic epithelium. Probably the principal sources of androgen are the interstitial tissue of the testicles and the adrenal glands. It has also been shown that by administering the female sex hormone—estrone—the growth of prostatic epithelium may be inhibited. Through research on sex hormone action, facts have evolved which tend to explain and give a scientific basis for some clinical observations that have been difficult to understand.

Another striking example of hormonal influence on tissues is the reaction of the endometrium to the ovarian hormones in the various phases of the menstrual cycle. It is notable that endometrial tissue in ectopic locations, *i.e.*, the oviduct, surface of the ovary, or elsewhere in the female pelvis, responds to the same hormone stimulus as in its normal location. Castration is followed by cessation of this local growth tendency, with the result that the cyclic periods of cellular proliferation of the endometrium and subsequent regressive changes promptly discontinue.

Great impetus has recently been given the study of the results of castration in man. Kutscher and Wolbergs (3) and Gutman and Gutman (4) have made extensive studies of acid phosphatase concentration in the serum and certain tissues of the body. In the prostate low values were found in children, becoming slightly higher through puberty and high in the adult. Huggins and his collaborators (5-7) continued these investigations and confirmed the findings by the use of staining methods for acid phosphatase in the prostate. They also found that the enzyme phosphatase of the adult prostate paralleled in quantity the extent of the hypertrophy as well as the amount of carcinomatous change that had taken place in the organ. These findings, with others, led them to conclude that the cells of prostatic carcinoma, in their cases, were of adult type rather than the primitive undifferentiated type usually found in malignant neoplasms. They have recorded another finding which appears useful, having found the serum-phosphatase level to remain within the bounds of normal in hypertrophy and localized cancer of the prostate, but to be greatly altered in the presence of bone metastases. When the estimates were high, metastasis had invariably occurred, though a few cases in their series showed only low levels even with secondary deposits present in the skeleton. It is obvious that high levels are almost positively diagnostic of bone metastasis. Another significant development in the work of Huggins and his associates was the demonstration that these mature types of cells from the prostate in ectopic locations retained androgen sensitivity, which is analogous to the estrogen sensitivity of cells of ectopically located endometrial tissue in the female. It was further demonstrated that when androgen-stimulated hyperplasia was reduced, evidence of local repair of bone lesions followed. Furthermore, when the androgen stimulus was withdrawn in these cases, clinical improvement occurred promptly and longevity was extended.

This research has demonstrated beyond the criticism of the most skeptical that the withdrawal or regulation of the androgen effect on certain tissues constitutes an-

other very definite step in the control of cancer. Just how we should undertake to alter this androgenic effect remains undecided. Huggins and his co-workers believe that orchiectomy gives the best result. While they report a certain amount of discomfort and some undesirable reactions, they still feel that the results justify this surgical measure. Improvements which they noted in certain far-advanced cases seemed most gratifying. In this group of patients, high serum-phosphatase levels were reduced to the range of normal values in a matter of hours. In the group where clinical improvement was slight or unchanged, the serum-phosphatase levels were only slightly altered. It was concluded that under these circumstances androgen was being produced at loci other than the testicle. In these cases the investigators attempted the reduction of androgen by the action of estrogenic agents (stilbestrol). Here they found that some of the cases responding poorly to surgical treatment presented favorable results, and in some, marked clinical improvement was observed, with the acid phosphatase levels reduced to a par with the most favorable group following orchiectomy. Their experiences with fever therapy were not encouraging.

Reporting on "The Effect of Orchiectomy and Irradiation on Cancer of the Prostate" in a recent issue of the *Annals of Surgery*, Huggins presents two cases in which radiation was given a trial. In one case, high-voltage x-rays (800 kv.) with high filtration, used over four portals (anterior, posterior, and two lateral hip portals), produced symptomatic relief for two months. When the symptoms recurred, a second series was given, with the testes unscreened. This time the relief of symptoms lasted for about six weeks. Rectal examination showed the prostate to be nodular and greatly enlarged, and roentgenograms revealed osteoplastic metastases in the right side of the pelvis. Orchiectomy was then performed.

Another case was similarly treated but with somewhat lower voltage (200 kv. constant potential). The testicles were protected with lead rubber. A second exposure was given six months later without the lead rubber protection. General clinical improvement was noted and the prostate gland remained hard and nodular. Orchiectomy was performed three months later, with prompt symptomatic relief and reduction in the size of the prostate gland.

The pathological report in both these cases showed profound atrophy of the germinal epithelium with preservation of the Sertoli cells and apparent or real hyperplasia of the Leydig cells. Huggins concludes: "It was thus apparent that roentgen ray irradiation in the amounts stated is ineffective in destroying the secretory function of the testicles and is inadequate as a therapeutic agent in prostatic cancer in man." Based on the microscopic findings, the conclusion is that, by irradiation, germinal epithelium of the testes was profoundly affected, but the interstitial tissues from which androgenic agents are derived was unaffected.

Munger (8) reported a series of 76 cases of carcinoma of the prostate treated by resection, planned x-ray therapy (without protection of the testicles), and adjunct or additional irradiation directly to the testicle. The cases reported were observed over a period of five years ending December 1938. At the time of the report (May 1941) 51 patients were known to be dead and 18 were known to be alive. Of 12 patients in whom resection alone was done, all died; of the group of 45 treated by resection and irradiation, 10 were alive; of the 11 treated by resection, irradiation, and adjunct x-ray therapy, 8 were still alive. This latter group showed prostatic recovery on digital physical examination. The longest period of survival was seven years; the shortest was three years.

Estrogens, it is believed, reduce the serum phosphatase in carcinoma of the prostate in the following ways: (*a*) direct action on prostatic epithelium; (*b*) neutralization of androgen; (*c*) depression of the gonadotropic agents from the anterior

lobe of the pituitary gland; (*d*) depression of the activity of the interstitial cells of the testicles. It appears that both the epithelium and the interstitial cells of the testicles show hypoplasia as a result of estrogen administration, and it also seems that this effect is more or less temporary. It has not been ascertained that benefits resulting from orchiectomy are permanent because, if for no other reason, the cases have not been observed for sufficient length of time in the light of modern clinical and diagnostic methods.

While the androgen-producing cells of the testicles were not adequately depressed by x-rays in the work that has been reported, and the results of efforts to control the androgens produced at points other than the testicles are but temporary, there may yet be a useful place for radiotherapy in these locations, *i.e.*, the adrenal, the pituitary, etc. The first objective in treatment of carcinoma of the prostate would seem to resolve itself into an effort to reduce or withdraw androgenic effects entirely, if possible.

As we acquire knowledge of the growth effects and influences of the sex hormones, there appear interesting points of analogy, the study of which may be helpful and elucidating. An outstanding similarity is that of the cells in metastatic deposits from carcinoma of the prostate and those of the endometriomata or ectopically located endometrial tissue. In each instance the cells are of the mature type, and in each sensitivity is retained for the respective sex hormone; estrogenic activity is inhibited by androgen administration, and conversely androgen activity is checked by estrogen. Again, ovulation and gametogenesis are restricted temporarily or arrested permanently by controlled doses of irradiation. Finally, the relative frequency of myometrial and endometrial hyperplasia shows an interesting analogy to prostatic hyperplasia during the same decades of life.

Hormone control of growth is essential in the normal development of the breasts. Imbalance in early life is certainly responsible for the unusual hypertrophies, as virginal hypertrophy, gynecomastia, etc. It is only in the later decades of life that hypergonadism carries its cell growth influence beyond benign hyperplasia. Lacassagne (9*a*) states that carcinoma can occur only in a mammary gland which has undergone a certain degree of development and that this development depends upon the estrogenic and pituitary hormones. He found, also (9*b*), that excessive amounts of estrogen caused squamous metaplasia of the prostatic epithelium, especially in the posterior lobe and in the verumontanum, and that continued administration to mice resulted in such extreme metaplasia that urinary retention was produced.

Tumors of the adrenal and ovary are known to increase the output of certain ketosteroids in the urine, and recently Satterthwaite, Hill, and Packard (10) noted high levels of the 17 ketosteroids in the urine when prostatic cancer had metastasized to bone. In these cases the output of the 17 ketosteroids showed a drop of 12 to 60 per cent from the preoperative level after orchiectomy, paralleling closely the changes in the serum phosphatase estimations.

Castration of women to produce an artificial menopause by surgical methods was advocated by Schinzinger (11) in 1889. He also called attention to the benefits experienced by certain patients with carcinoma of the breast, after an artificial menopause. In 1896 Beatson (12) observed shrinkage of the primary breast tumor, reduction or disappearance of skin nodules, and regression of lymph node metastases after the surgical removal of the ovaries.

Foveau de Courmelles (13), in 1907, published reports of castration by irradiation for carcinoma of the breast. This work was begun as early as 1904. Wintz (14) and other radiologists have been using irradiation castration as a part of the treatment of breast cancer since about 1920. Because radiation castration reduces hormonal activity, more may be

expected from this procedure during the period when hormone production is at its peak, *i.e.*, in the third and fourth decades of life. Just when sex hormone production reaches a very low level or ceases entirely following the menopause is not known. It is obvious that its influence on normal cyclic cell growth is decreased or lost entirely late in life, and the factors concerned with neoplasia in the primary and secondary sex organs at this period are probably quite independent.

It cannot be doubted that the hormone status associated with pregnancy and lactation exaggerates malignant disease of the breast. In view of our present knowledge of such cases, the demands for treatment are: first, termination of the pregnancy, preferably by the irradiation method, and if the products of conception are not spontaneously expelled in due time, careful surgical removal; second, preoperative irradiation of the affected breast in all of these early cases, followed by surgical removal and postoperative irradiation of the affected side, as well as of the unaffected breast and axilla. With this plan of management the patient will experience an early menolipsis. It is also advisable to continue irradiation of the pelvis at intervals of sixty to ninety days, until all of the symptoms of the climacterium have ceased, or for at least two years, regardless of symptoms. In all of these cases it is well to administer some androgenic agent, such as testosterone or desoxycorticosterone propionate in daily doses of 10 mg. or more, during preoperative irradiation and at intervals postoperatively.

The prime objectives of this plan of management are: first, to withdraw the estrogenic effects by arresting the principal source of production; second, the interruption of pregnancy, which automatically follows profound alterations in estrogen production; third, a direct radiation effect on functional hyperplasia of the breast epithelium as well as the localized neoplasia; fourth, surgical extirpation of the local disease; fifth, exercise of continued radiation effects over the primary and the secondary sex organs, as well as control by endocrine therapy for sufficient time to allow these broken functions to return to a state of stability.

In closing, it affords me great satisfaction to know that achievements through scientific medical management now prevent and control many conditions of the primary and secondary sex organs of both the male and female which are so vitally concerned with proliferative and regressive processes. Radiation therapy has contributed liberally.

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DISCUSSION

William Thaw Clark (Janesville, Wis.): I should like to ask Doctor Orndoff one question. Does he know of any series of cases of breast cancer that will show a difference in the results of oophorectomy and x-ray castration comparable with the effects of orchiectomy and roentgen castration in prostatic carcinoma?

Doctor Orndorff (*closing*): Castration of the female for breast cancer by surgical methods is not at all new. Lawson Tate and Bland Sutton in England, Schinzinger in Germany, and others recommended it before the days when Halsted and Willy Meyer created the epic period of radical surgery for

cancer of the breast. In a review of the literature, however, it is found that a contributor would report a comparatively small series of cases in which oophorectomy had been performed, calling attention to its favorable influence on the tumor growth and general health; then for some reason the work would be discontinued, or at least no further record would appear. At a later date an entirely independent group of workers would report results of another series of cases. Furthermore, it is noteworthy that the percentage of good results would always remain about the same, *i. e.*, about 30 per cent.

In a study of reported cases of breast cancer treated by irradiation castration it seems fair to say that favorable reactions are claimed in about the same percentage of cases—approximately a third of those treated. In the light of more recent developments promising results are to be expected.

It has been quite well established clinically that with the occurrence of pregnancy cancer in the breast becomes more flagrantly malignant and the interruption of the pregnancy is amply justified. Furthermore, castration by surgery or irradiation is warranted. At this point I would like to emphasize, as I have endeavored to bring out in this presentation, the necessity of continuing a maintenance dose of irradiation for many months after a complete menolipsis has been established.

The advantage to be gained by castration of the male or female through surgery or by irradiation involves a consideration of many unanswered problems. Much can be said in support of either method but I am not familiar with the work of anyone who has made a comparative study of sufficiently sizable groups of cases to warrant definite conclusions. Personally, I am inclined to favor radiation castration in most cases.

Use of the Basal Metabolic Rate in the Management of Radiotherapy for Leukemia[1]

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THIS STUDY OF the relationship between basal metabolism and leukemias was prompted by the following clinical observation:

In 1939 a patient previously treated for lymphatic leukemia presented himself for follow-up examination. He was at that time in excellent health, had a white count of 14,000 cells, a normal differential count, no lymphadenopathy, and no other clinical signs of leukemia. A routine determination of his basal metabolism, however, revealed a rate of +69 per cent. Since the patient felt perfectly well, the possibility of an error was considered, and the test was repeated one week later. The second determination showed +71 per cent and the patient was kept under close observation. Check-ups on the basal metabolic rate at weekly intervals showed no change, but four weeks after the first test, generalized lymphadenopathy developed, the patient grew continuously weaker, and within two more weeks the white count rose to 160,000 cells. Following x-ray therapy instituted at that time, the basal metabolic rate dropped within three weeks to +16 per cent, the white count decreased to 120,000 cells, but the lymphadenopathy showed little change. Therapy was then discontinued in order to observe the course of the disease. Within one month, the white count dropped to 18,000 cells and all clinical symptoms disappeared.

The importance of this observation seemed to lie in the fact that the pathological change in the basal metabolic rate manifested itself earlier than any other sign or symptom of the disease and was influenced by therapy earlier than all other manifestations. It seemed worth while to investigate this problem more intensively.

The fact that the basal metabolic rate is elevated in a majority of patients suffering from leukemia is, of course, not a new observation. The phenomenon has been known since the last decade of the nineteenth century, when the early studies on metabolism were carried out (1, 2). In contrast to similar studies in thyrotoxicosis, however, this observation did not create any special interest among investigators until the year 1911. At that time, Grafe (3) reported his observation that leukemic blood cells have a high oxidative metabolism and that there seems to be a relationship between the degree of leukocytosis and the elevation of the basal metabolic rate in leukemia patients. Grafe's report inspired further investigations on the significance of the elevated basal metabolism in leukemias in three directions:

1. The nature of leukemic cells.
2. The possible relationship between leukemia and thyrotoxicosis.
3. The importance of determinations of the basal metabolic rate for following the clinical course of leukemias.

1. The morphological studies of leukemic blood cells did not facilitate a decision whether leukemias, which frequently are defined as tumors of the blood and the hematopoietic system, belong in the group of benign or malignant neoplasms. Grafe's investigations were the first clinical application of O. Warburg's newly developed method for physiological studies of cell metabolism. Warburg (4) had been able to show that under aerobic conditions normal cells have a rather high oxidative and

[1] From the Tumor Clinic (Erich M. Uhlmann, M.D., Director) of Michael Reese Hospital and the Department of Medicine (Prof. G. F. Dick, M.D., Chairman) of the University of Chicago. Presented before the Radiological Society of North America at the Twenty-eighth Annual Meeting, Chicago, Ill., Nov. 30–Dec. 4, 1942.

only a slight glycolytic metabolism, whereas malignant cells are characterized by a reversal of the respiration-glycolysis ratio, that is, they have a high aerobic glycolysis and a small oxygen consumption. This method became popular and was widely used for further investigation of the nature of leukemic blood cells. Barron and co-workers (5), Glover and co-workers (6), Schlossmann (7), Peschel (8), and Soffer and Wintrobe (9) reported results which did not always agree, but in 1939, Kempner (10) in carefully controlled experiments proved that the immature leukemic blood cells (myeloblasts and lymphoblasts) have a purely oxidative metabolism and do not form lactic acid under aerobic conditions; furthermore, that they "exhibit the characteristic metabolism of uninjured young cells and not that of cancer cells." The high basal metabolic rate of patients with leukemia must be considered the expression of the high oxygen requirement of the leukemic blood cells, and this fact would demonstrate that the leukemias constitute a special and singular type of neoplasm. No other neoplastic disease is to our knowledge characterized by an elevation in oxygen requirement.

2. The similarity of leukemias and thyrotoxicosis in their behavior toward oxygen uptake raises the question whether this represents only a symptomatic coincidence or whether other similarities may exist between these two diseases. Minot and Means (11) compared the increase in pulse rate in leukemia and thyrotoxicosis with the elevation of the basal metabolic rate and found that "the amount of pulse elevation for a given metabolic rate is the same in both diseases." Turner and co-workers (12), among others, studied the iodine level in the blood of leukemia patients and found that it is almost as high as in thyrotoxicosis. Friedgood (13) formulated the hypothesis that disturbances of the sympathetic nervous system together with generalized lymphoid hyperplasia might be the underlying factor in the pathogenesis of exophthalmic goiter as well as in lymphatic leukemia. He therefore tried treatments with Lugol's solution in leukemia which, however, proved to be ineffective (14). On the basis of the same reasoning, Dameshek, Blumgart, and Berlin (15) performed a thyroidectomy on a patient with lymphatic leukemia in an attempt to influence the blood disease by lowering the basal metabolic rate. Although in this case the enlarged spleen decreased in size, no curative effect was obtained. It seems, therefore, that the high basal metabolic rate in leukemia and thyrotoxicosis, the increased pulse rate, and the elevated blood iodine level are symptoms produced by different mechanisms, though the final cause is unknown in both instances.

3. Grafe's original observation that the high basal metabolic rate in leukemia patients was related to the number of leukemic blood cells was confirmed by many investigators, especially by workers in this country. Boothby and Sandiford (16) found in 14 out of 16 patients with lymphatic and myeloid leukemia a basal metabolic rate above 20 per cent. In Gunderson's (17) series of 19 cases, the basal metabolic rate varied between +6 and +80 per cent, with a general tendency for the extreme metabolic rates to be associated with the highest leukocytosis. Similar findings were reported by McAlpin and Sanger (18) from their studies on a series of 16 patients during x-ray therapy. These authors also mention the fact that a rising metabolic rate sometimes foretold an approaching increase in the white blood cells. This observation is important, since it explains the discrepancy occasionally observed between the blood count and the basal metabolic rate, to which all authors in this field refer. It corresponds with the well known fact that the count of the white blood cells is not always an indication of the severity of the leukemic process, which depends more on the number of immature blood cells formed in the lymph nodes or bone marrow than on the number released into the blood stream.

The largest series of examinations has

been reported by Riddle and Sturgis (19), who carried out 267 basal metabolic rate determinations on 33 patients. Their findings, which are reprinted in Table I, demonstrate the general trend of parallelism between the basal metabolic rate and the blood count, as well as the individual variations and exceptions.

TABLE I: AVERAGE WHITE BLOOD CELL COUNT IN RELATION TO THE BASAL METABOLIC RATE IN CHRONIC MYELOGENOUS LEUKEMIA
(Abstract of a table from Riddle and Sturgis, 19)

Number of Estimations	Average Basal Metabolic Rate	Average White Blood Count (thousands per c. mm.)
3	−14	13.3
48	− 5	35.3
63	+ 5	72.2
38	+15	118.1
34	+24	189.0
8	+35	220.1
7	+45	111.4
5	+63	290.8
3	+72	142.2
1	+81	342.0

A number of careful observations, in which the same patient was followed over a long period of time, with determinations of the basal metabolic rate through the various stages of the disease, have also been published (Murphy, Means, and Aub (20) and others). Most of these authors agree with the statements of Lennox and Means (21) and of Krantz and Riddle (22), that the basal metabolism is a truer indicator of the activity of the leukemic process than the count of the leukocytes. Minot and Isaacs (23), therefore, as early as 1924, recommended that "the treatment of leukemia should be guided and the prognosis formulated from the correlated information obtained from the patient's history and physical signs together with complete blood examinations and basal metabolic rate determinations. . . . The basal metabolic rate becomes considerably elevated when the disease process is distinctly active, and irradiation then is indicated despite blood findings which sometimes do not clearly reflect the patient's condition."

It would seem natural that with such extensive studies the clinical value of determinations of the basal metabolic rate in patients with leukemia would be definitely established as a worth-while control in the treatment of leukemias. This, however, did not materialize, and the blood count remained in most instances the only laboratory index of the severity of the disease. The reasons for this development are manifold. On the one hand, technical inconveniences may have prevented the establishment of basal metabolic rate determinations as a routine method for leukemias in the same way as for thyrotoxicosis. On the other hand, the occasional discrepancies between basal metabolic rate and blood count may have influenced the decision not to rely on this method. Furthermore, it seems that the majority of clinicians, while considering the theoretical importance of this test, have failed to recognize its value for the actual clinical management of leukemias.

Minot and Isaac's conclusions, as well as McAlpin and Sanger's observation and our own findings, show that in many instances the basal metabolic rate is a more reliable test for the dynamic status of the leukemic disease than the blood count, since the basal metabolic rate is an expression of the actual hematopoiesis at the time, whereas the blood count may represent changes that have occurred earlier. The number of white cells in the blood, whether it is high or low, does not permit any conclusions as to the functional status of the disease. A low blood count may indicate a remission as the result of satisfactory treatment, but it may also be found if a new exacerbation is coming. The bone marrow or the spleen and the lymph nodes may be filled with new immature cells and yet the blood count may be low. On the other hand, a high white count may indicate great activity in the blood-forming organs and call for continuation of treatment. But the same high white count may persist for some time after effective treatment has paralyzed the hematopoiesis. In such instances, further treatments cause severe damage and precipitate aleukosis. In all

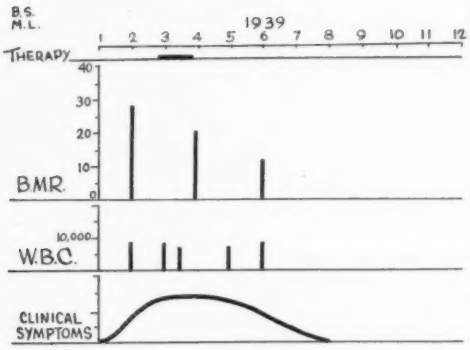

Chart 1. Myelogenous leukemia.

these instances, the basal metabolic rate may reveal the true functional state. A high basal metabolic rate, with or without a high white count, indicates that the disease is active and in most instances requires further therapy. Since the elevation of the basal metabolic rate often precedes the increase of the white blood cells, its determination will permit the institution of treatment much earlier than if the blood count is used as the only laboratory control. A low basal metabolic rate indicates that the disease is in remission, and that a high white count, if present at the same time, will decrease in due time without further treatment.

These statements are corroborated by our observations on patients suffering from lymphatic and myelogenous leukemias and in some instances of Hodgkin's disease where similar changes were found. This report includes continuous studies on 23 patients treated in the Tumor Clinic of Michael Reese Hospital: 12 with lymphatic leukemia, 10 with myelogenous leukemia, and one with Hodgkin's disease. In 7 of the 23 patients (3 lymphatic leukemias, 4 myelogenous leukemias), the basal metabolic rate at various times was within normal limits and did not rise above 10 per cent. In 5 others (3 lymphatic leukemias, 2 myelogenous leukemias), the basal metabolic rate was elevated in some instances above +50 per cent but, due to lack of co-operation on the part of the referring physicians or the patients, no chronological studies could be performed and the records are not sufficiently complete to show the true relationship between the basal metabolic rate and the status of the disease. In the remaining 11 patients (6 lymphatic leukemias, 4 myelogenous leukemias, 1 Hodgkin's disease), observations were continued over a considerable length of time—in most instances for many years—and these findings allow definite conclusions.

Our observations in some of these patients are graphically recorded and several of the histories are given briefly. The graphic charts illustrating the case histories are drawn in an arbitrary manner showing on the abscissa the time expressed in months and on the ordinate the administration of treatments, the elevation of the basal metabolic rate, the white blood count, and the clinical symptoms.

Chart 1 is that of a patient with myelogenous leukemia whose white count during the time of observation never rose above 10,000 cells. In February 1939, he began to have clinical symptoms indicated by a swelling of the spleen, weakness, and typical blood findings. The symptoms became worse during the month of February and were intensive in the beginning of March 1939. The basal metabolic rate on Feb. 1 was +28 per cent and x-ray therapy to the abdomen was started on Feb. 24. Eleven treatments of 25 r each were administered, for a total of 275 r, the last treatment being given on March 29. The basal metabolic rate taken on March 21 was +21 per cent at a time when the clinical symptoms had shown no change. No further therapy was given. The patient began to feel better in April 1939. In May the basal metabolic rate was +15 per cent, the spleen was much smaller but still palpable, the patient's general condition was very good. At the end of July the spleen was within normal limits and the patient in excellent condition.

Chart 2 is of a patient with lymphatic leukemia and shows the follow-up over a period of four years. In January 1939, the basal metabolic rate was +23 per cent, but this was before we paid special attention to this phenomenon. The patient received x-ray therapy (19 treatments for a total of 475 r) for his clinical symptoms and felt well throughout the year. In March 1940, his basal metabolic rate was up to +40 per cent without any clinical symptoms or pathological findings in the blood. One month later, however, typical changes in the blood and lymphadenopathy occurred, with malaise and weakness. Therapy was instituted at that time,

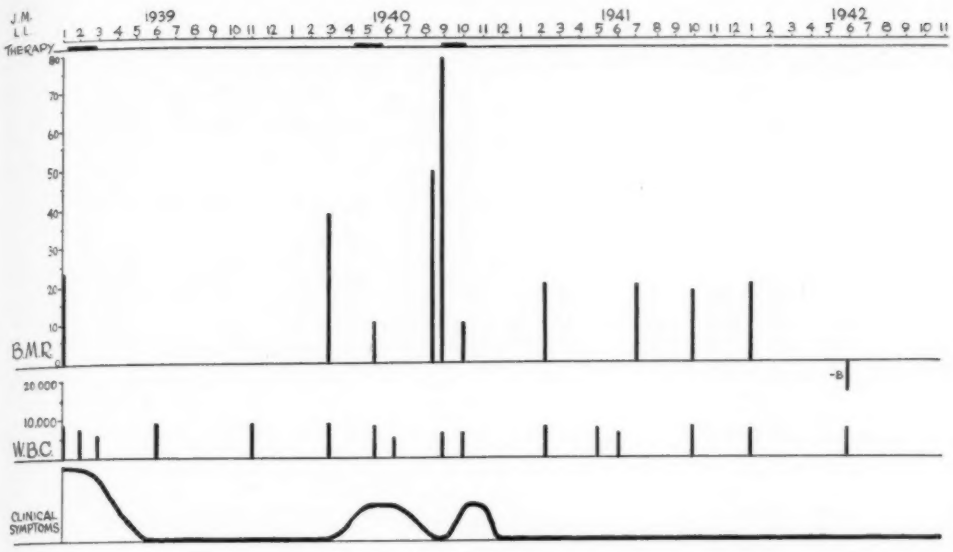

Chart 2. Lymphatic leukemia.

small amounts of x-rays given over the involved areas. The treatments were stopped when the basal metabolic rate showed a decrease to +9 per cent, in May, in spite of the fact that clinical symptoms were still present. Six weeks later the patient felt well without further treatments. In August 1940, while he continued to feel perfectly well, the basal metabolic rate was up to +48 per cent and two weeks later reached +78 per cent. Small lymph nodes were palpable, but the patient was comfortable. One week later x-ray therapy was started, because the swelling of the lymph nodes began to increase. After seven treatments, the basal metabolic rate dropped to +8 per cent. Again therapy was interrupted while the lymphadenopathy was still present and again after six weeks no symptoms were to be found. It is noticeable that, as in the first patient, the white count never rose above 10,000 cells. The patient has been followed and, until the beginning of 1942, his basal metabolic rate remained around +20 per cent. At one time it dropped to minus 8 per cent (May 1942), but clinical symptoms did not appear and no further therapy was given.

Chart 3 registers the history of a patient with myelogenous leukemia where the same principal relations between the clinical symptoms and the basal metabolic rate were observed. The case is reported to show the immediate influence of x-ray therapy on the basal metabolic rate, the short courses of treatment necessary, and the small amounts of radiation given (single doses of 25 r, totals of 200 r, 275 r, 315 r, respectively, in the three series of treatments). Furthermore, this patient had a marked increase in the white count which at times was as high as 80,000 cells, but the influence of therapy on the cell count manifested itself much more slowly and less reliably than on the basal metabolic rate.

Chart 4 shows the history of a patient with lymphatic leukemia observed over a period of two and one-half years. Again the count of the white cells gives no clue as to the severity of the disease, but the parallelism between the basal metabolic rate and clinical symptoms is obvious. During the time of observation, the patient had four remissions and a high basal metabolic rate preceded the clinical symptoms with almost surprising regularity. Treatments were given whenever the basal metabolic rate showed extreme values and consisted of single doses varying between 15 and 35 r. The total amounts of radiation given in the four series were 85 r, 85 r, 110 r and 85 r, certainly a remarkably low dosage. Therapy was stopped as soon as the basal metabolic rate started to decrease, and the clinical symptoms disappeared in due time. The basal metabolic rate taken in December 1941 is not recorded; it was originally given as +76 per cent but later it was reported that a technical error had been made in the determination, and it is therefore noted in the chart with a question mark.

Chart 5 covers a period of observation of four years in a patient with lymphatic leukemia who required treatment on three different occasions. In this case, the basal metabolic rate was at an average of +20 per cent even in the symptom-free intervals, but before each recurrence of clinical symptoms it rose above this average (up to +40 per cent in May 1940). The white count varied between 3,500 and 13,500, but was of relatively little significance as an index of the severity of the

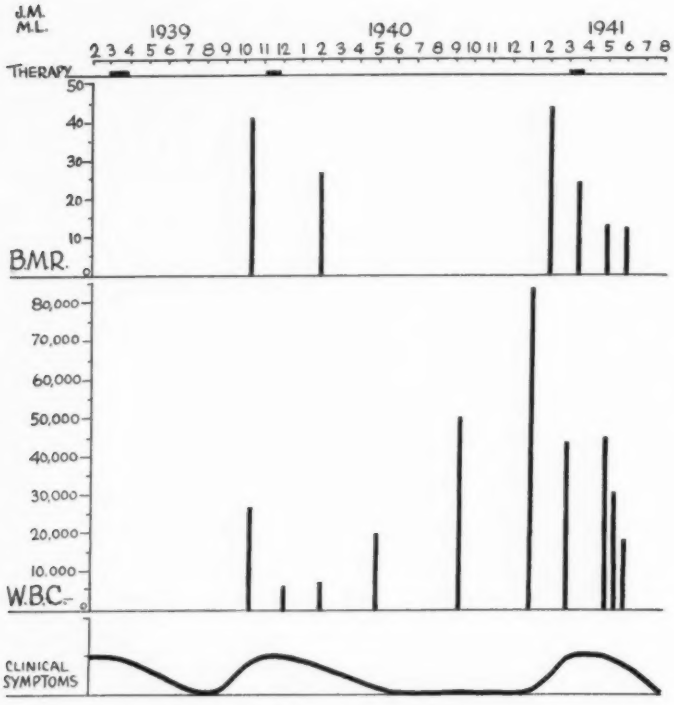

Chart 3. Myelogenous leukemia.

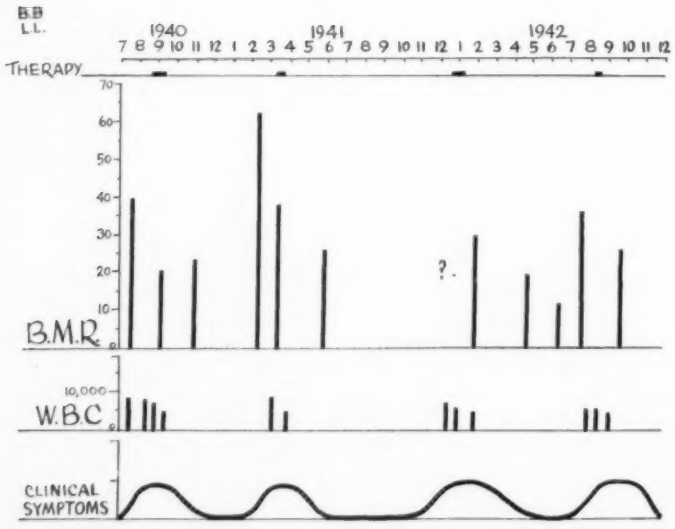

Chart 4. Lymphatic leukemia.

patient's condition. Again the total amounts of x-rays given in a series were remarkably low, being between 250 and 275 r.

Chart 6 is that of a patient with lymphatic leukemia over a period of two and one-half years with findings similar to those in the patient represented by Chart 5. In this case, however, the number of white cells, while never being very high (maximum

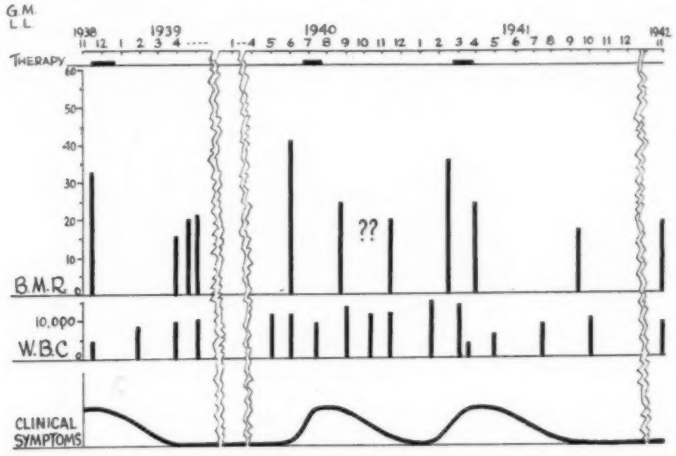

Chart 5. Lymphatic leukemia.

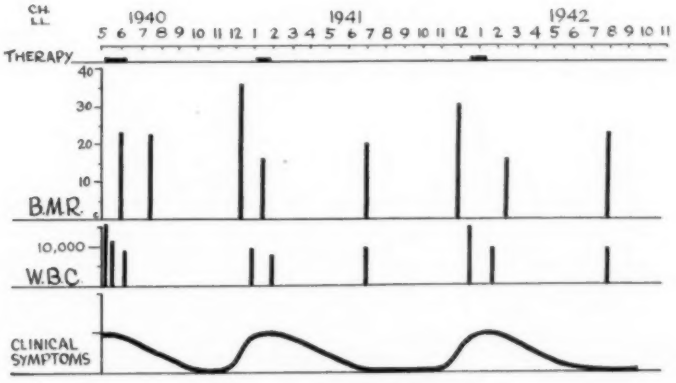

Chart 6. Lymphatic leukemia.

15,500) showed a definite response to therapy. The patient had been under care in the department since 1935 without control of the basal metabolic rate, and relatively large amounts of x-rays were given from 1935 to 1940. With the basal metabolic rate as a guide, a total of only 170 r and 245 r were given during the year 1941.

Chart 7 is of special interest, since the patient was suffering in all probability from Hodgkin's disease. He was under our observation for almost three years and biopsies taken from the enlarged lymph nodes were very suggestive, though not conclusive, of this diagnosis. In December 1939, the patient was in extremely poor condition with generalized lymphadenopathy and malaise. The white blood count was normal and the differential blood picture showed no abnormalities. The basal metabolic rate at that time was +29 per cent. Following x-ray therapy, the clinical symptoms gradually improved, and the basal metabolic rate dropped to +8 per cent in May 1940. One month later, lymphadenopathy again developed, and in spite of the fact that the basal metabolic rate was only +3 per cent, therapy was instituted, with the result that the clinical symptoms disappeared. At that time we had not had sufficient experience in judging the relation between basal metabolic rate and symptoms in the leukemias, and no ex-

perience whatever with the relationship in Hodgkin's disease. Following x-ray therapy, the basal metabolic rate dropped to −2 per cent and remained at that level. In May 1941, the basal metabolic rate was −3, and with great hesitancy we administered x-ray therapy again, since the patient was suffering from general lymphadenopathy and weakness. The symptoms disappeared and the basal metabolic rate dropped to −7 per cent. The patient then felt well for six months, when clinical symptoms recurred. The basal metabolic rate was now +2 and we decided to refrain from any therapy so long as the symptoms were not so severe as to require hospitalization. After six weeks the symptoms subsided spontaneously without treatment, and the patient was able to resume his activities as a traveling salesman. In July 1942, the basal metabolic rate began to rise slowly from +11 per cent to +16 per cent to +22 per cent in November, and the patient again had symptoms. At that time he had left Chicago and, in spite of our urgent advice, did not return to the hospital or undergo medical care elsewhere. He was finally admitted to another hospital, where he died in December 1942. We feel it worth while to mention the case here because there seems to be a relation between the basal metabolic rate and the clinical symptoms in Hodgkin's disease, even if it is less significant and reliable than in the leukemias.

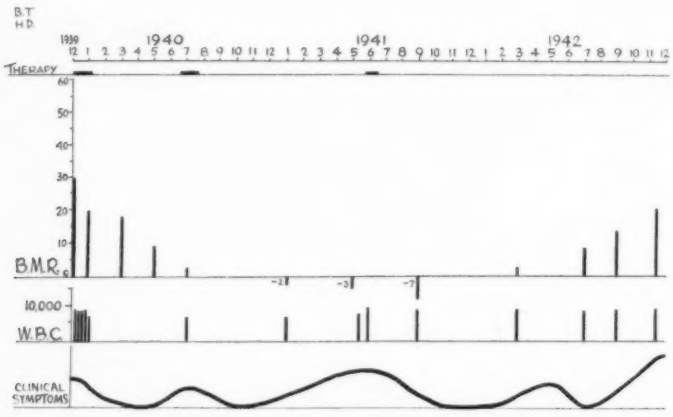

Chart 7. Probable Hodgkin's disease.

The conclusions to be drawn from these examples, and from observations in many more instances with shorter periods of follow-up, are suggestive. In patients suffering from lymphatic or myelogenous leukemia, and, as we found, even in patients with Hodgkin's disease, where the basal metabolic rate is abnormally high, the regular performance of this laboratory test will be of significance in evaluating the course of the disease. In the majority of patients under our observation, the basal metabolic rate was the first indication of an approaching exacerbation of the symptoms, preceding the clinical signs, and in most instances changes in the blood, often by weeks. On the other hand, when therapy was effective in the disease, the basal metabolic rate was the first symptom to show this influence clearly. It could, therefore, be used to indicate the time for initiating and terminating treatments.

It may be recalled that up to twenty years ago it was thought desirable, when x-rays were used in the therapy of the leukemias to continue treatments until the white blood count declined to normal. In many patients this proved to be fatal, since a leukopenia developed from which they did not recover. For the past two decades, the general condition of the patient receiving x-ray therapy has been much more closely watched, and treatments have generally been interrupted when an improvement in the subjective symptoms indicated a change, even though the white blood count had not decreased to normal figures.

Observation of the basal metabolic rate in those patients in whom it is elevated

(and they are in the majority) is a laboratory test which gives better and more definite indications for the interruption of the treatments than other tests or symptoms. We have been able to produce excellent clinical results by administering only a fraction of the doses previously used and believe that this is of advantage for several reasons. First, the small amount of radiation which is sufficient to clear up the symptoms does not generally produce any ill effects. Secondly, if the dose of x-rays is limited, the patient will become resistant to irradiation at a much later date than with the large amounts hitherto applied. This latter fact—if proved over a period of years, as our observations seem to indicate—would very probably increase the life expectancy of patients suffering from leukemia to a considerable degree. Since x-rays are only a symptomatic remedy for the disease and as yet no causative therapy is known, the most effective and the most economic application of radiation therapy is certainly indicated, and the determination of the basal metabolic rate seems to facilitate this task.

While it is not the purpose of this paper to enlarge on technical details with regard to the application of x-ray therapy in leukemias, it may be mentioned that in most instances, unless circumscribed severe lymphadenopathy required local treatment, x-rays were applied at a distance of 100 cm. over the trunk, with single doses of 15 to 35 r. The number of treatments given varied between 2 and 13, and the patients tolerated these treatments extremely well.

SUMMARY

Clinical observations and a review of the literature show the close relationship of the basal metabolic rate and the severity of the clinical symptoms in patients suffering from leukemia. The basal metabolic rate is elevated in a majority of these patients when an exacerbation of the disease is approaching and decreases as soon as therapy is effective. This is usually long before any other manifestations (white blood count, enlargement of spleen, lymphadenopathy, subjective symptoms) show response to therapy. It is recommended, therefore, that the evaluation of the basal metabolic rate be used in determining the proper time for initiating and terminating therapy. It will be found that, by following these suggestions, very small amounts of x-rays are sufficient to control the disease. This in turn permits the patients to tolerate the treatments and may even substantially increase the life expectancy by deferring the time when resistance to therapy develops.

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DISCUSSION

Raphael Isaacs, M.D. (Chicago, Ill.): Doctor Uhlmann has brought out a very important point in connection with the treatment of leukemia. When we think of leukemia, we naturally think of something wrong with the blood. The name itself—white blood—shows that attention is focused on the blood. As time has gone on, however, we are changing that attitude and are focusing our attention on the place where the blood cells are made. There may be some fundamental disease of the bone marrow or of the spleen or the lymph nodes and the pathological process may be limited to those organs, while the blood itself shows no significant change. The condition of the blood in such cases may therefore be misleading.

When a person has leukemia, the bone marrow, for example, grows at an extremely rapid rate, filling every possible space in the bones, increasing in amount from two to five times. When bone marrow cells grow very rapidly, they absorb oxygen and as an increase in oxygen utilization occurs, the patient uses more oxygen. The amount of oxygen in the blood stream is roughly proportional to the amount taken into the lungs, and the amount taken into the lungs is roughly proportional to the amount used in breathing, which, of course, is the clinical basal metabolic rate.

The basal metabolic rate, therefore, is indicative of the condition of the patient; it is more expressive of the extent of the disease than the actual blood count, since the latter is an accident; that is, some cells from the leukemic tissue may accidentally get into the blood stream and produce an abnormal count but, on the other hand, this "accident" may not happen.

After x-ray therapy, as is shown in the charts, the basal metabolic rate may rise from one to three days before it starts to fall. This is interesting, since, if you study the bone marrow at that time, you will find that the actual number of cells may be increased—and sometimes the cells in the blood stream, also—at least during the first twenty-four hours. Then, as the cells mature, they die of old age or of necrosis, whichever you wish, and their number decreases. Thus, the increased number of cells after x-ray therapy is also related to the increase in basal metabolic rate in the first twenty-four or forty-eight hours.

It is not always necessary to make a basal metabolism test. This may not be feasible or it may not be within the patient's means. There are several clinical features by which one can judge whether or not the rate is elevated. For example, loss of weight in spite of a fair appetite, intolerance to heat, abundant perspiration, especially night sweats, irritability, restlessness, and a "jittery" feeling.

The word "jittery" seems to apply particularly well in these cases. The patient with hyperthyroidism is nervous; all his muscles are tense and he is having tremors. Here, on the other hand, he merely feels jittery, for the reason that one of his organs is working four or five times as fast as the rest of his body, which is trying to relax. The pulse rate is more rapid than normal. There are, to be sure, other features which may cause a rapid pulse rate, but as a rule the elevated basal metabolic rate is fairly proportional to the increase in the pulse rate. One author says that 7 per cent increase in pulse rate corresponds roughly to 10 per cent rise in the basal metabolic rate.

Still another point to be considered is the feeling of weakness. The first clinical symptom that a patient notices when he has leukemia is a sense of weakness, ease of fatigue, and we wonder why this appears so much earlier than a change in the white blood count. I think Doctor Uhlmann has given the answer to that question, for while the blood cell count may not rise until some time later, the increase in the basal metabolic rate accompanies the change in the bone marrow.

Inhalation Pneumonia from Nitric Fumes[1]

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ACUTE INHALATION pneumonias caused by noxious fumes are increasing in frequency. With the complexity and volume of wartime industry, and indeed with wartime hazards themselves, the roentgen appearance of such pulmonary accidents assumes a special significance. The roentgen literature, however, contains few recent accounts of the findings.

Many industrial gases are potentially dangerous. Of particular interest are the acute pulmonary changes resulting from the inhalation of nitric fumes, especially those produced by welding. While there are numerous gases and fumes arising in the welding arc or flame, most of the ill effects of inhalation have been ascribed wholly or in part to the oxides of nitrogen (1, 2, 4, 7, 8, 9, 10, 11, 12, 13, 14, 17, 19, 21, 22, 23, 24, 25).

Nitric fumes occur extensively in industry (9, 15), but unless the fumes are generated in confined, unventilated places, the concentration is not of sufficient degree to be toxic (2). From time to time, however, accidents do occur and there then results an acute pulmonary picture with severe reactive changes. The patient, if removed from the noxious environment, may recover following a pulmonary episode of varying severity, or the response may be an overwhelming edema of the lung and death.

We have studied the chest roentgenograms of two patients who became acutely ill following the inhalation of nitric fumes. Both recovered. In the first instance the fumes were generated by the open-vat mixing of nitric acid with hydrochloric acid. In the second case they were formed by acetylene welding in the hold of a ship. Garland (5) recently suggested the term "nitric fume pneumonia" or "pneumonia complicating nitric fume poisoning" to designate this condition. Although both of our cases were associated with the inhalation of nitric fumes and the clinical syndromes were similar, we are reluctant to adopt this specific terminology, since we believe that many inhaled chemical irritants may cause a similar response. Doub (3) reports that nitric fumes and the war gases, phosgene, diphosgene, chlorine, and chloropicrin, produce similar pulmonary exudative changes, with a similar clinical course. With some variations among the different gases, the bronchopulmonary response may range from irritation to rapid death following pulmonary edema (13). We therefore prefer the more inclusive term, "inhalation pneumonia." This discussion will, however, be limited to nitric fumes, since they appear to have been the offending factor in our cases.

Nitric fumes occur in those industries where nitric acid is used (15), as in the production of sulfuric, picric, and chromic acids; in the manufacture of toluene, metallic nitrates, methyl nitrate, celluloid, nitrocellulose (gunpowder), collodion, Prussian red, English red, etc.; in metal testing, the manufacture of jewelry and of artificial pearls, engraving, the manufacture of artificial leather, and the production of explosives (nitroglycerine, dynamite, etc.). The fumes arise, also, in connection with the industrial use of nitric acid compounds, such as nitrates, nitrocellulose, nitrobenzene, and aniline, and in the commercial preparation of nitric oxide by the Haber method. To this list Johnstone (9) adds tunnel working, mining, carbon arc-booth operating (moving pictures), and all types of welding as sources of nitric fumes.

It is believed by some (2) that the nitrous gases make the body more sensitive to carbon monoxide and that a combination of

[1] From the Department of Roentgenology, Kings County Hospital, Brooklyn, N. Y., Richard A. Rendich, M.D., Director. Accepted for publication in July 1943.

factors is responsible for some of the reported deaths.

Nitric fumes consist of five oxides of nitrogen (2): nitrous oxide (N_2O), nitrogen trioxide (N_2O_3), nitrogen pentoxide (N_2O_5), nitric oxide (NO), and nitrogen peroxide or nitrogen dioxide (NO_2 or N_2O_4). The dioxides are said to be the most insidious and toxic of the group. They are the brown fumes seen in reactions of nitric acid. In whatever molecular form the dioxide is inhaled (15), it is altered to that corresponding to body temperature. At 40° C. approximately 30 per cent is in the form of NO_2 and 70 per cent is in the form of N_2O_4. It is in this proportion that the gases act on the respiratory tract. N_2O_4 reacts with the water of the respiratory membrane to produce nitric acid and nitrous acid:

$$N_2O_4 + H_2O = HNO_3 + HNO_2$$

NO_2 reacts with the air and moisture in the respiratory tree to produce nitric acid and nitric oxide:

$$3NO_2 + H_2O = 2HNO_3 + NO$$

Pulmonary accidents due to nitric fumes must certainly date back to antiquity. The electric arc was discovered in 1812 by Davey. According to Britton and Walsh (2), who give an extensive bibliography on the subject of health hazards of welding, Cavendish shortly afterward discovered that nitrogen oxide was formed in the electric arc. La Towsky *et al.* (11) refer to the first autopsy in a case of nitrogen fume inhalation, performed by Cherrier in 1823. From time to time since then, occasional references to the subject have appeared. More recently, the nitrocellulose film fire in Cleveland (16) with its disastrous pulmonary effects due to inhalation led to renewed interest in the problem. Of late, especially in the foreign literature, there have been scattered reports of serious pulmonary accidents or deaths ascribed to nitric fumes produced by welding in poorly ventilated places (1, 2, 7, 8, 9, 10, 12, 14, 17, 18, 25) or in other industrial tasks, such as working with acids (3) or dynamiting (6).

The pathological changes in the lungs may be expected to vary with the intensity of the exposure. With a mild inhalation there may be no reactive changes or only a slight inflammatory response in the mucosa of the tracheobronchial tree. With inhalation of larger amounts the inflammatory changes extend farther downward to include the minutest bronchioles, and secretion into the lumina and vascular engorgement are more prominent. With still greater severity, acute hyperemia and edema around the bronchioles result in pulmonary infiltrations, giving a miliary or nodular appearance. A sterile bronchopneumonia follows. Up to this point the process is reversible and the patient may recover, with no residual changes. More advanced or severe damage may terminate in death due to injury to the respiratory epithelium and alveolar and capillary walls, resulting in marked extravasation of fluid and pulmonary edema. Failure of the right heart may be present (14). Nichols (16) states that pulmonary edema may be either slight or so extensive that the patient drowns in his own secretions. If death occurs after an interval, miliary fibrous nodules may be found at the terminal bronchioles (16, 20). Congestion, bronchopneumonia, purulent bronchitis, and pleural effusions all play a part (16). With severe exposures, methemoglobinemia may be a prominent cause of rapid asphyxia (11). Lung changes due to chronic inhalation have been described among welders. They resemble a nodular silicosis and are said to be due to the deposition of iron oxide, a component of the welding fumes, and not to the nitric components. In a limited group of cases, the exposure is insufficient to cause a rapid termination, but the injured respiratory tract constitutes a fertile field for bacterial invasion so that a delayed pneumonitis or a bronchopneumonia may supervene (11).

The signs and symptoms of nitric fume inhalation are usually delayed (9). There may be a latent period after exposure of from several hours to twenty-four to thirty hours. For that reason, there is no

doubt that many cases of nitric oxide fume inhalation in industry go uncompensated, since the relation between cause and effect is not apparent. The fumes are more irritating to the lung than to the nasopharynx, so that they may be inhaled for a long time without the patient becoming aware of it. He may see the fumes, but is not warned by any distressing symptoms such as the immediate dramatic effects upon the upper respiratory passages produced, for example, by chlorine or ammonia.

The initial symptoms are headache, dizziness, palpitation, a sensation of pressure upon the anterior chest wall, and a dry cough. These may disappear completely if the patient is exposed promptly enough to fresh air. They are followed shortly by a chill, elevation of temperature, severe respiratory distress, and cyanosis. Where the exposure has been limited, the picture may resemble that of an acute bronchitis or a severe attack of asthma, with physical signs of coarse, moist râles and rhonchi throughout the lungs. Such patients usually recover and there is a gradual subsidence of respiratory symptoms over a period of several days to one or two weeks. Their acute illness or convalescence may be complicated by lobar or lobular pneumonia with all its attending manifestations. In that event, recovery may occur after weeks of remissions.

Where the concentration of gas has been higher or exposure more prolonged, death usually takes place within forty-eight hours. The irritating effect upon the respiratory mucous membrane is so overwhelming that the patient literally drowns in his own edema fluid. In such rapidly fatal cases the pathological findings will be limited to the lungs. Where, less commonly, death is delayed for one or two weeks, right heart failure, pleural effusions, pulmonary congestion and infection, anemia, and focal hemorrhagic lesions in various organs, all play a role. It should be re-emphasized, however, that the initial and the fundamental effects of inhalation stem from trauma to the respiratory mucous membrane.

Although there is no definite proof of chronic pulmonary disease occurring as a direct effect of nitrous fumes, certain symptoms, as headache, sleeplessness, anorexia, weight loss, and a dry cough, have been attributed to prolonged low-grade exposure to these fumes (9).

The roentgen features in cases of acute nitric fume inhalation are of particular interest. The x-ray appearance must be interpreted in the light of our knowledge of the type of irritant and the pathological changes that result. As Sante has pointed out, the inhaled fumes, carried to the minutest bronchioles, cause an irritative bronchiolitis which is manifested in the roentgenogram as an irregular soft mottling throughout the lungs (20). These submiliary, pseudonodular patches of increased density follow the course of the bronchiolar tree and extend out to the very periphery of the lung. They have a more or less even distribution and show no hilar or central preponderance as would the lesions of cardiac decompensation or pulmonary azotemia, which they resemble. Although initially they tend to be discrete and pseudonodular, they subsequently merge and become confluent as edema and minute areas of atelectasis are superimposed on the initial changes caused by irritative bronchiolitis and hyperemia. Later, areas resembling confluent patches of bronchopneumonia may appear and, if bacterial invasion occurs, the roentgenographic picture will be further altered.

With a rapid fatality, the lungs are bathed in edema fluid. In those patients who recover, however, the most striking roentgen feature is the astonishing rapidity of resolution of the widespread exudative infiltrations. Serial roentgenograms taken only a few hours apart will demonstrate perceptible clearing. As the acute edema subsides, the pseudonodular infiltrations disappear, leaving in their place only exaggerated lung markings caused by the composite shadow of engorged blood vessels and corroded bronchi and bronchioles. Within a few days, even these latter findings are no longer seen. In favorable

cases, only four to ten days elapse from the time of exposure until complete disappearance of roentgenographic evidence of inflammatory pulmonary response. Unless infection supervenes, there are no residual manifestations (3, 6, 7, 18). Nichols, in studying the films of patients exposed to burning nitrocellulose fumes, found submiliary nodules in the lungs of those who made a prolonged recovery. These nodules, however, faded after two weeks and were attributed to a transient interstitial fibrosis replacing the acute exudative response.

If it is understood that the action of the nitric fumes is upon the superficial lining of the tracheobronchial tree, then the explanation for the reversible character of the pathological changes and the resulting roentgenographic lesions is clear. If exposure had been so severe that necrosis of the lining membranes had occurred, with the resulting formation of granulation tissue, we might expect residual findings. Such overwhelming exposure is, however, more apt to result in rapid death, either from asphyxia or an irresistible pulmonary edema.

CASE REPORTS

CASE 1: A. M., white male aged 46, entered Kings County Hospital on March 2, 1941, because of severe respiratory distress of one day's duration. He had previously been in good health, but had had a mild cough for several weeks. At the time of admission he was engaged as an odd-job man by a metal-cleaning firm. On the day of admission, he had spent approximately half an hour mixing nitric acid with hydrochloric acid. He wore no mask. Although he was conscious of the fumes, they caused him no distress. About one hour after he had inhaled the fumes, he experienced paroxysms of cough and pain over the upper chest anteriorly. Very shortly thereafter he felt chilly and ill.

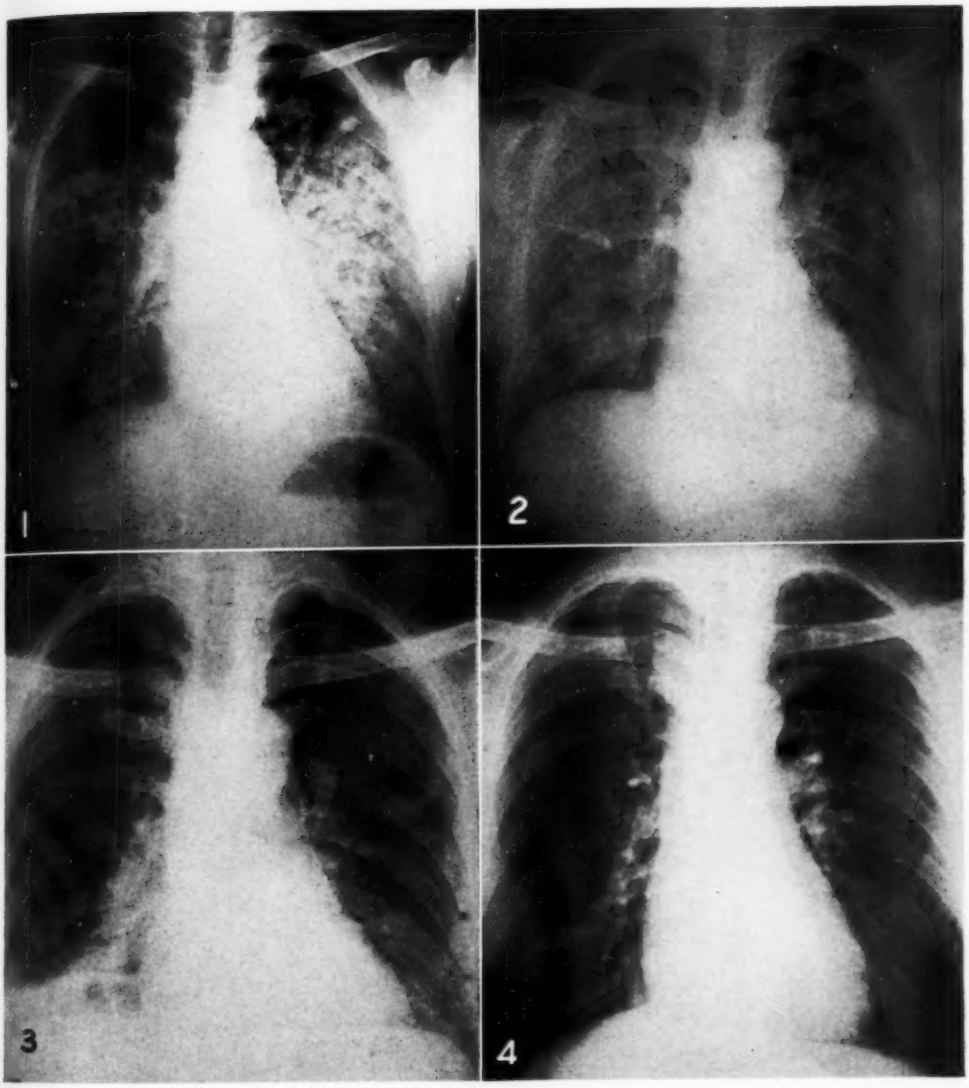
The patient was first seen approximately twelve hours after the inhalation. He was well oriented but was acutely ill, with severe respiratory distress, a dry cough, and moderate cyanosis. The temperature was 103.2°, pulse rate 120, respiratory rate 40 per minute. The blood pressure was 105 systolic and 70 diastolic. The chest expanded equally bilaterally. The percussion note was resonant throughout. Moist râles were heard throughout both lung fields. The heart was not enlarged. Its sounds were regular and of good quality. The remainder of the physical examination was negative.

The blood Wassermann reaction was negative. Three blood cultures were sterile. The initial blood count (March 3) revealed a hemoglobin of 14.0 gm., 4,200,000 red cells, and 18,500 white cells with 87 per cent polymorphonuclear leukocytes. A second blood count, eight days later, gave a hemoglobin of 12.0 gm. with 6,500 white cells, of which 70 per cent were polymorphonuclears. The initial blood chemical studies revealed a urea determination of 80.0 mg. per 100 c.c. of blood and a creatinine determination of 2.3 mg. per 100 c.c. of blood. Two days later (March 5) the urea was 45.0 mg., the creatinine 1.8 mg. On March 11 the blood urea had returned to normal, 22.0 mg. per 100 c.c. of blood. On three occasions urine studies were negative. The specific gravity of the urine varied between 1.025 and 1.020.

On admission, oxygen was administered and the patient also received sulfapyridine therapy. At no time was there sputum to type. The cyanosis and dyspnea were slightly diminished the next day, but at that time the patient was drowsy and poorly oriented, though he responded to questions. Within four days of admission the symptoms had almost completely regressed and the temperature had returned to normal. On two subsequent occasions a rise of temperature to 103° occurred, but these elevations of temperature were not associated with a recurrence of the initial symptoms. By the eighth hospital day, the patient was sufficiently recovered to sit up in bed. He was discharged after seventeen days in the hospital. He refused to return to his old occupation.

The initial roentgenogram (Fig. 1), taken the day after admission, was reported as showing "evidence of confluent areas of bronchopneumonic consolidation involving the major portions of both lung fields. The configuration of many of the areas of infiltration is somewhat nodular and dense, suggestive of an underlying occupational disease (pneumoconiosis)." Interval studies were advised to differentiate between a simple bronchopneumonic process and an inflammatory one superimposed on an underlying silicosis. The inhalation aspect of the roentgenogram with its attending bronchiolitis was not appreciated. Two days later, a second roentgenogram (Fig. 2) revealed a "marked degree of resolution of the formerly described areas of consolidation throughout both lung fields. Residual areas of interstitial change persist at the site of previous involvement. Findings, therefore, previously described are those of an acute inflammatory process." A third roentgenogram, six days later (Fig. 3), revealed "complete resolution of diffuse infiltration, except for a plate-like area of atelectasis or pneumonitis at the right base. There was residual accentuation of pulmonary trunk markings, particularly in the hilar regions." No further roentgenograms were taken before the patient's discharge eight days later.

Almost a year afterward, when the roentgenograms of Case 2 were studied, their marked similarity with those of this case and the history of



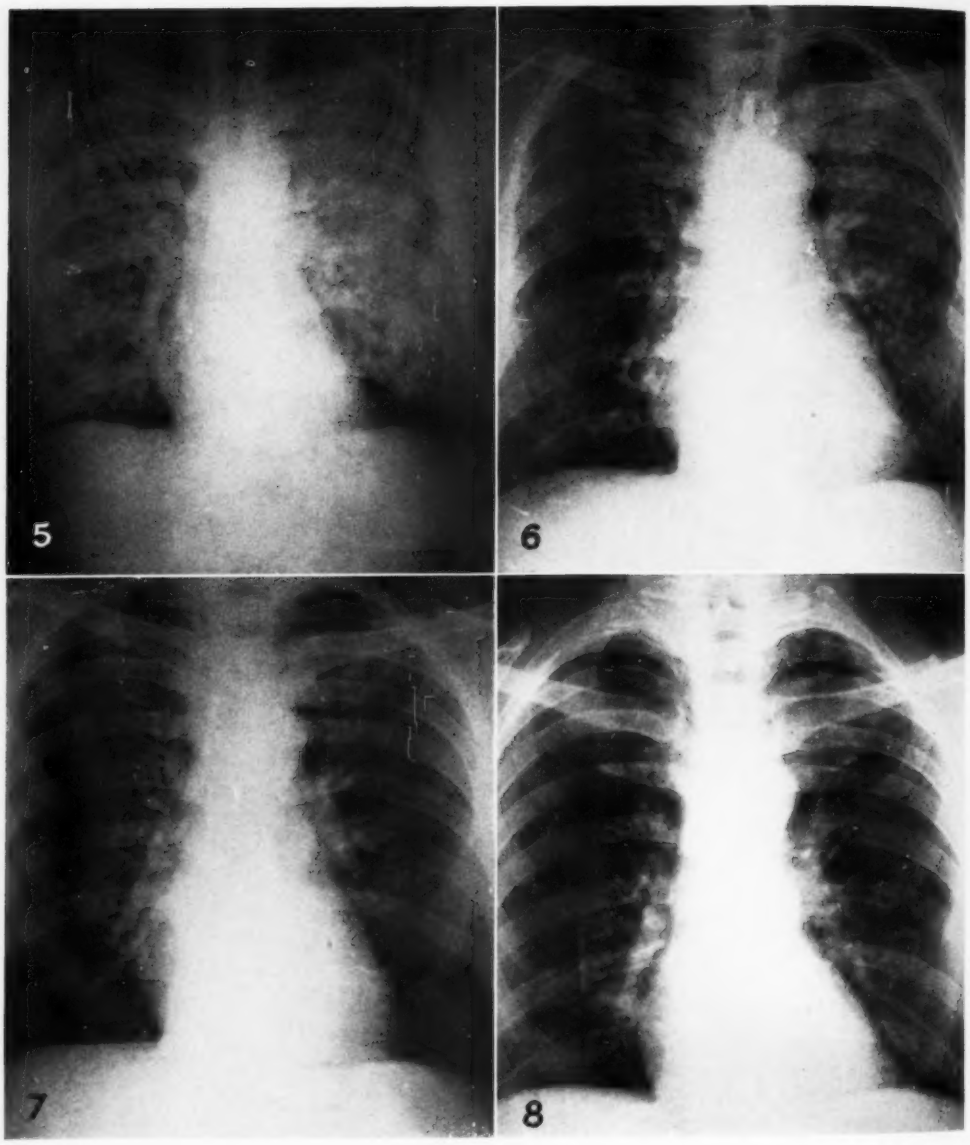
Figs. 1–4. Case 1.

1. Appearance the second day after the patient had inhaled nitric fumes produced during the mixing of nitric acid with hydrochloric acid. Note the pseudonodular character of the infiltrations.
2. Appearance two days later. The process had begun to subside.
3. Eight days after the original roentgenogram, the lungs had cleared with the exception of an area of atelectasis or pneumonitis in the right lower lung field. This was a complication of the original process which had cleared.
4. Eleven months later no residual changes could be detected.

exposure to fumes in both instances led to a restudy of the films. The patient was located and a follow-up roentgenogram was obtained. During the interval he had been well and free of all respiratory complaints. Figure 4 is the roentgenogram taken on Feb. 14, 1942, eleven months after the original exposure. There are no residual parenchymal infiltrations.

CASE 2: J. M., white male aged 49, a coppersmith and sheet metal worker by trade, entered Kings County Hospital on Jan. 10, 1942, complaining of headache and dizziness of one day's duration. He stated that he had always been in good health.

On Jan. 9 the patient reported to work at 7 A.M. at a shipyard. His job that day was to assist a welder in the brazing of pipes by means of an acetylene



Figs. 5–8. Case 2.

5. Appearance the second day after the patient had inhaled nitric fumes produced during acetylene welding.
6. Appearance two days later. The process had begun to subside.
7. Four days after the original roentgenogram, the lungs had almost completely cleared with the exception of a few faint infiltrations, the size of a match head, in the central lung fields.
8. One month later no residual changes could be detected. The linear shadow in the right lung field is an artefact.

torch. They were working in a ship's hold, "three decks down." In the process of welding, fumes were liberated which could be seen and smelled. The welder wore a gas mask, but his assistant, the patient, did not have one. From 7 to 11:30 A.M. he was exposed to the fumes. He continued to work until 4 P.M., when, because of his dizziness, he went to the dispensary. There, after being given a gas to inhale, he felt slightly better. He had been coughing on and off since morning. The same night he was so dizzy

that he called an ambulance and was admitted at 2 A.M., Jan. 10. It is interesting to note that he stated that the welder whom he assisted also felt "sick," despite the mask.

The patient was a husky, middle-aged man. He was moderately dyspneic; his respirations were shallow. He coughed frequently but produced no sputum. His temperature on admission was 100.2°, pulse 100 per minute, respiratory rate 35 per minute. His blood pressure was 135 systolic, 70 diastolic. There was a diffuse erythema over his face. The chest expanded equally bilaterally. There was no impairment of percussion. Many moist râles were heard over the lower halves of the lung fields. The heart was not enlarged and auscultation revealed a regular rhythm without murmurs. The remainder of the physical examination was negative.

The blood Wassermann reaction was negative. Further laboratory studies were not available. The patient was never very uncomfortable. On the morning after admission, his dizziness and headache had disappeared. After three days, his dyspnea and non-productive cough were no longer present. His temperature varied between 99 and 100.6°. On the fourth day, Jan. 14, he stated that he felt "fine" and was sent home.

The initial roentgenogram (Fig. 5) was taken on the day of admission, the second day of illness. It was reported as showing "a generalized submiliary pseudonodular infiltration throughout both lungs. The nodules vary from match-head to pea size. The changes are compatible with an acute exudative reaction with severe bronchiolitis and submiliary bronchopneumonia following the inhalation of an irritant." Two days later, it was reported (Fig. 6) that "the formerly noted irregularly sized areas of nodular infiltration have regressed to approximately half their former size." In two days, the picture had changed from one of widespread confluent infiltrations indicative of bronchiolitis and surrounding edema to one of only faintly outlined pseudonodular patches surrounded by considerably reaerated lung. On the day of discharge a third roentgenogram (Fig. 7) revealed an almost complete subsidence of the findings. A few residual infiltrations the size of a match head were present in the right central lung field.

A follow-up study on Feb. 9, 1942 (Fig. 8), one month after the exposure, during which time there had been no recurrence of symptoms, revealed complete absence of residual parenchymal changes.

DISCUSSION

In each of the cases described above, the patient became acutely ill following the inhalation of nitric fumes. Although the fumes were generated under different circumstances, the effects on the lungs appeared to be identical. In each instance the chest roentgenogram was characterized by an unusually widespread pseudonodular infiltration completely filling both lung fields. During the most acute stage the infiltrations varied in size from that of a match head to a pea. In many areas these were confluent, forming larger patches; however, the nodular appearance was easily recognized (Figs. 1 and 5). It appeared as if the irritant had been inhaled to the smallest bronchioles, with local response to the resultant chemical inflammation. Acute hyperemia and edema around the bronchioles resulted in the pulmonary infiltrations giving the nodular appearance. Fortunately the noxious agent had been inhaled in amounts which still permitted a quick recovery of the respiratory mucous membranes, with a resultant rapid subsidence of the lesions. Roentgenograms of both patients taken two days after the first views showed considerable resolution. The infiltrations were much smaller and discrete (Figs. 2 and 6). Clinically, the patients were improved. An interval examination was obtained eight days after the initial study of the first patient (Fig. 3). At this time no evidence of the original infiltrations remained. An area of atelectasis or interstitial pneumonitis was present in the right lower lung field and was felt to be a complication. No residual changes could be detected eleven months later (Fig. 4). In the second patient an interval study was obtained four days after the original examination (Fig. 7). With the exception of a few faint infiltrations in the central lung fields, the size of a match head, the lungs had almost completely cleared. The patient felt "fine" and was discharged. A follow-up study one month later revealed complete absence of residual change (Fig. 8).

SUMMARY

1. Two cases of inhalation pneumonia from nitric fumes are presented.

2. Although the fumes were generated under different circumstances, the pulmonary pictures appeared identical.

3. The roentgenograms were characterized by unusually extensive pseudo-

nodular infiltrations which completely studded both lung fields.

4. In these patients, both of whom recovered, there was a very rapid subsidence of the pulmonary findings, coinciding with clinical improvement. Considerable clearing could be noted after two days. Both patients were re-examined after an interval. No residual changes were noted. More extensive damage than was caused here might result in residual pulmonary changes or death.

5. We are reporting these cases because we believe that the incidence of this entity is increasing and because, as in our first patient, the condition may be unrecognized. This is significant from both a therapeutic and medicolegal standpoint.

6. It is hoped that the report of such cases will stimulate prophylactic industrial measures.

7. We prefer the less specific terminology, "inhalation pneumonia from nitric fumes" or "pneumonia complicating nitric fume poisoning" (Garland), to "nitric fume pneumonia," since we believe that other inhaled chemical irritants may cause a similar picture. Irritations of lesser severity than seen with our cases might more aptly be designated by the term "bronchiolitis."

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Peyronie's Disease or Plastic Induration of the Penis[1]

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PLASTIC INDURATION of the penis, usually referred to as Peyronie's disease—so named because this pathological entity was first described by him—has only recently attracted widespread attention. We reported 6 cases in 1934, in which radiation therapy had been given with fairly satisfactory results (6).

At that time, our search through the literature revealed some two hundred odd cases recorded. Today, we find approximately 650 cases listed by authorities from many nations. We have now studied and treated 11 more patients, as shown in the accompanying table. Though our cases constitute only a relatively small percentage of those reported, yet, from these few, together with information from more comprehensive reports of clinicians, we can draw some conclusions. The study reveals that all methods of treatment have been, and still are, largely empirical.

Surgery may be considered inadequate or, at best, applicable to only a limited number of patients with superficially localized lesions, not basically keloid. If we consider the lesion as practically purely keloidal, we can state frankly that any operative procedure, to be successful, must be accompanied by either preoperative or postoperative radiation therapy, preferably the former.

Available literature shows that encouraging results have been obtained in a goodly proportion of patients by the use of x-ray or radium alone, or the two in combination. This undoubtedly indicates some degree of sensitivity to radiation. There is, in our opinion, no ideal technic which is universally applicable. In this affliction, as in every other, one must make an individual study of each patient and apply with common sense whatever treatment schedule is prescribed.

We have observed that the majority of patients are over forty years of age and that the main complaint is pain and distortion upon erection, with interference with coitus, which may even be impossible. It is for this particular disturbance that most patients seek relief. It is also true that if the induration is overcome, the patients in the over-fifty-years-old group complain that they no longer feel the thrill of the biological urge and hence lose interest in and respect for the doctor who is responsible for their post-treatment condition. Despite the fact that in our latest patients we have achieved the best clinical results with the 4-gm. radium pack and have screened off the testicles most carefully and thoroughly, we are apparently unable to prevent loss of libido. It appears, therefore, that the individualized long-wave radiation technic fractionated over the necessary time period is to be preferred.

Various authorities have made use of every known type of radiation, from the practically unfiltered, low quantity scale of radiation energy to the shortest wave lengths available. Strange to say, practically all of these methods have been followed by satisfactory results. This tends to prove that Peyronie's disease is definitely radiosensitive and is pathologically of true keloidal or sclerotic type. If this hypothesis is tenable, the reason for surgical failure is easily understood. On the other hand, experience has shown that keloids of all types are more easily controlled by radiation therapy in the younger generation than among the elderly. Nevertheless, the pathological factors are identical and we feel certain that a careful study of each individual patient will suggest ways and means for prescribing a

[1] Presented before the Radiological Society of North America, at the Twenty-eighth Annual Meeting, Chicago, Ill., Nov. 30–Dec. 4, 1942.

dose schedule from which beneficial results may be forthcoming. It is not necessary to point out that a sufferer from plastic induration of the penis, particularly in the younger group, must have relief, and, as pride goeth before a fall, he must be informed that total relief of the induration by radiation therapy may bring inability to enjoy the marital relationship to a satisfactory conclusion.

By and large, Peyronie's disease is perhaps more common than generally acknowledged, inasmuch as it is possible that many cases go unrecognized and unreported. According to Fricke (5), who has made a very careful analysis, the average duration before treatment is sought exceeds twenty months and the condition occurs most often in middle life.

The etiology still remains obscure. Numerous authors attribute the condition to trauma, venereal disease, gout, diabetes mellitus, rheumatism, tuberculosis, alcoholism, infectious disease, etc., but no conclusive proof has been offered as to any definite causative factor. Practically all keloids are resultant from trauma or chronic irritation. Therefore, it is quite reasonable to suspect an acute urethritis or a gonorrheal invasion of the urethra as the dominant factor in the causation of Peyronie's disease. We believe that this is a possible and practical assumption.

As is well known, plastic induration of the penis affects the dorsum of the sheath of the corpora cavernosa, the septum between the corpora, or both of these structures. There is an elongated thickening of these tissues, which to the palpating finger feels dense and resistant, appearing like an actual thickening of the sheaths themselves. Burford (1) emphasizes the fact that, although the condition is not common, it should be clinically recognized so that the patient may have the assurance that his condition is not malignant; also, that treatment in the hands of a competent radiologist offers a possible cure or, at least, very definite improvement.

Johnson (2) believes that surgical removal offers the best chance of cure, but time and experience have not substantiated this statement. The consensus of opinion seems to be that x-ray therapy, radium alone, or the two in conjunction, will give the best results. McKay (3) states that surgery is not indicated and will probably prove to be harmful rather than beneficial.

In 1940, Burford (1) collected 590 cases from the literature and reported an additional 40, making a total of 630 cases reported to date. In 18 of his cases, he used the radium plaque applicator with 7 or 39 per cent cured and 8 or 45 per cent improved. Of the 19 untreated cases, 1 apparently improved spontaneously, while in the remaining 18 the condition did not change. In the other 3 cases, Burford used violet ray exposures without benefit. He maintains, like many others, that the most noticeable results are obtained by x-ray and radium, and states that a certain amount of skin irritation or even radiation necrosis may result from radium plaques.

Of a series of 80 patients reported by Fuhs (4), 27 did not complete treatment. Of those treated, 43 per cent were cured, 43 per cent improved, and 14 per cent remained unchanged.

In 1939, Fricke (5) reported on 34 cases. Two patients died suddenly of cardiac failure and were excluded from the series and 1 case was lost. Of the 31 cases traced, 18 had one treatment, with 11.2 per cent good results and 22.2 per cent fair results, while 66.6 per cent were unimproved. In 10 cases, two treatments were given with 30.0 per cent good results and 40.0 fair results, while 30.0 per cent did not improve. Three patients had three treatments: in 1 of these (33.3 per cent) results were good, in 1 fair, and 1 was unimproved.

Fricke believes that radium treatment has many advantages, as the absence of harmful after-effects, avoidance of injury to skin and edema of the tissues, and a definite time-saving element, since the treatment requires but one over-night period with a further over-night application three to four months later. He believes that the earlier the condition is treated, the better the prognosis. In the later stages,

TABLE I: PEYRONIE'S DISEASE OR PLASTIC INDURATION OF THE PENIS: ELEVEN CASES SEEN FROM 1936 TO 1942

Name of Patient and Year Treated	Age	Duration of Disease	Extent of Disease on Examination	Treatment (at Los Angeles Tumor Institute)	Present Status
E. C. D., 1936	55	2 weeks	5 × 2 cm., mid-portion	Radium	No induration
C. C. T., 1937	56	Not stated	1 × 2.5 cm., posterior portion	Radium	Lesion smaller
D. E. F., 1938	65	6 months	1 × 2 cm., posterior portion	Radium*	No induration
E. D. L.	49	1 year	Slight diffuse induration, anterior portion	None	Improved
G. B. F., 1939	58	6 months	Diffuse induration, anterior portion	Radium and 200 kv. x-rays	No induration
W. K. N., 1939	57	4 months	1.5 × 2 cm., posterior portion	Radium	Induration 50% less
A. E. O., 1940	52	4 months	Extensive induration involving and surrounding all of urethral area	200 kv. x-rays and radium	No induration
P. H. S., 1941	46	2 months	1 × 2 cm. Very dense posterior portion	Radium and 100 kv. x-rays	No evident change
L. S.	52	6 months	1 × 2 cm., surrounding posterior urethra	None (patient returned home for treatment)	
D. E. B., 1942	47	5 months	Small dense induration, mid-portion	Radium	Improved
B. B. H., 1942	68	3 months	1.5 × 3 cm., posterior portion	Radium and 100 kv. x-rays	Lesion reduced 50%

Results: Failures 1; improved 5; clinically well 4; no treatment 1.

* This patient had previously had radium therapy elsewhere.

treatment should not be urged except as a therapeutic test.

Our own results in 6 patients treated before 1935 will be found elsewhere (6). The 11 cases seen more recently are presented in the accompanying table.

CONCLUSIONS

It is apparent that x-ray and radium therapy of various types have been found useful in checking the activities of plastic induration of the penis. It now remains our duty to correlate all facts gathered, to the end that a dosage schedule may be standardized which will be most effective with the majority of patients who seek relief for this condition.

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A Technic for Optic Foramen Roentgenography[1]

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ROENTGENOGRAPHY of the optic foramina has been facilitated by the Pfeiffer angle device (1). Recently an adaptation of the Bullitt mastoid localizer for this purpose has been described (2). The necessary apparatus for these procedures, however, is often unavailable in the average roentgenologist's office or hospital, where calls for such examinations are infrequent. Under these circumstances, roentgenograms of the optic foramina usually are made by taking oblique views of the orbits. The orbital rim is pressed against the cassette and the central ray is directed from above downward, passing through the external canthus of the eye so that the orbit is portrayed as a circular shadow on the film (3). We have noted that the latter technic frequently foreshortens the optic foramen shadow, which appears as oval rather than circular. It is also somewhat difficult, with this procedure, to obtain comparable views.

We sought a method which would eliminate the use of mechanical devices and still give fairly uniform results. Satisfactory roentgenograms of the optic foramina have been obtained repeatedly with the following technic.

FIG. 1. Position of patient for examination.

TECHNIC

Place the cassette on a 2-inch block. Focus a cone with a 3-inch aperture so that the central ray passes through the center of the film. Elevate the tube and cone, and with the patient in the prone position place the head so that the malar eminence, the tip of the nose, and the superior orbital ridge form the apices of a roughly equilateral triangle in the circular roentgenographic field. Then elevate the superior orbital ridge one inch from the

[1] From the Radiologic Service of M. G. Wasch, M.D., The Jewish Hospital of Brooklyn. Accepted for publication in June 1943.

FIG. 2. Roentgenograms showing optic foramina.

cassette. A wedge of felt may be used to maintain the proper position (Fig. 1). The central ray is thereby directed perpendicularly downward, passing about 3/4-inch mesial to the external canthus of the eye. On the roentgenograms the optic foramina appear as circular structures in the lower portion of the orbits (Fig. 2).

We have obtained the same results with the use of an angle board employing a 15° angle. A slot was cut in the base into which a 5 × 7-inch or 8 × 10-inch cassette fitted. It was necessary to groove out the inclined plane to permit the cassette to be inserted its full length. The center of the roentgenographic field was marked by a cross. In use the tube is first centered over the cross, and the head is then placed so that the superior orbital ridge, the nasal tip, and the malar prominence are in contact with the inclined plane, the orbit occupying the middle area. A single view may be obtained on a 5 × 7-inch film, or two views may be taken on an 8 × 10-inch film by masking out the appropriate fields. A lead mask may be used to pre-expose the films so that the finished roentgenogram presents a black periphery. The angle board can readily be constructed in any carpenter shop.

The physical factors used are as follows: approximately 55 kv.; 50 ma. seconds; cone 7 inches long, with 3-inch opening; screens, par speed.

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EDITORIAL

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Congenital Dislocation of the Hip

There has never been a very general agreement as to the exact mechanism of congenital dislocation of the hip. It has been variously ascribed to several developmental changes. One school holds that it is primarily a bone defect, the result of deficient development of the acetabulum with poor formation of the posterior rim. Others believe that it is due to a relaxation of the capsule and ligamentous structures, with secondary bone changes resulting from the lack of articulation. It is of interest, therefore, to find a new etiological concept described in a recent communication by Badgley (1). He is unable to correlate the clinical, embryological, and anatomical facts with a theory based on a primary fault inherent in the development of the acetabulum. He cannot understand how, if such a theory were correct, so large a percentage of patients with preluxation could go on to normal development after treatment. In a series of 478 cases of preluxation of the hip, treated in the first year of life by Putti's method of abduction and internal rotation of the hip, excellent results were obtained in 94 per cent.

Badgley's contention is that the deformity is secondary to anteversion of the head and neck of the femur with a resultant secondary hypoplasia of the acetabulum. The chief evidence available of congenital dislocation of the hip in early embryonic life is to be found in arthrogryposis multiplex congenita, and for this reason a special study was made of that syndrome. The conclusion is reached that the characteristic posture of the limbs in arthrogryposis is definitely that of an arrest in development, with failure of normal rotation of the limb bud. The extrinsic and intrinsic factors producing this arrest must be assumed to be the marked muscle atrophy and degeneration and the rigidity of joints characteristic of this condition. The "secondary acetabulum" as described in these cases is not a true secondary acetabulum but actually represents a failure of development of the anterior margin of the ilium from pressure by the femoral head. Hypoplasia of the posterior superior margin of the acetabulum, which has been supposed to be the inherent acetabular defect in congenital dislocation, may well be due to similar pressure produced by anteversion of the head of the femur rotating the neck against the posterior acetabular rim. In further support of his theory, the author calls attention to a series of 500 cases of clubfoot, with evidence of dislocation of the hip in 39, and cites Böhm's theory of the embryological origin of clubfoot as an arrest of development of the hind foot which prevents its normal rotation.

Badgley feels that there is an intrinsic design for the form of the acetabulum but that extrinsic forces play an increasing part in the later stages of development. The ultimate shape of the mature socket and head and neck of the femur is acquired adaptively by perfect timing in the alteration of the reciprocal relations of the femoral head and acetabulum coincident with growth changes. From his studies, the author advances the hypothesis that interference with the normal rotation of the limb buds, which produces an interruption in the normal turning in of the head on the socket, even temporarily, allows the head and the acetabulum to be

molded abnormally by the extrinsic factor of loss of the normal reciprocal relationship of the component parts. With more serious interference with normal rotation of the limb bud, the head is prevented from turning into the acetabulum, which is already misshapen by the loss of pressure stimulus. With continuance or resumption of torsion, anteversion increases and may lead eventually to dislocation.

Summing up his observations, Badgley concludes that congenital dislocation of the hip results from failure of normal rotation of the limb bud, with secondary flattening of the socket and anteversion of the head and neck of the femur. The anteverted femoral head points anteriorly, with the neck lying against the posterior rim of the socket and with the trochanter posteriorly. Hypoplasia of the posterior rim results from this faulty pressure. With the flat socket a gradual posterior displacement of the head and neck occurs partly as a result of the greater angle produced by the os innominatum with the acetabulum at its apex, probably aided by the pull of the gluteal muscle.

This is an interesting approach to the study of the etiology of a condition which is frequently encountered and which is not always easy to correct.

* * * * * *

An interesting review of the end-results of bloodless reduction of congenital dislocation of the hip is given by Gill (2), though he found it difficult to arrive at definite percentages of cure since many of the patients drifted away and were lost sight of. Ninety-eight cases were available for study during the second year after reduction, and of these 14 (14.3 per cent) showed a perfect result, and 7 (7.1 per cent) results which may be called excellent. Fifty-five of this group were operated upon, and 9 had redislocation without subsequent operation, making a total of 64 cases, or 65.3 per cent of the series, having proved unsuccessful reductions. The satisfactory results would therefore lie between 21.4 and 34.7 per cent. The author stresses the fact, however, that these percentages are of relative value only, as some of the patients who disappeared showed excellent results up to that time and others can be expected to suffer relapse even as late as the twentieth year.

In bilateral dislocations, where reduction was possible, the end-results were as good as in single dislocations. It should be noted, however, that it is in bilateral dislocations that the very severe degrees of congenital deformity occur.

Failure of cases to remain reduced after removal of the fixation dressings and resumption of the original leg position proved that many hips are not amenable to successful bloodless reduction. The author has never operated in one of these unsuccessful cases, however, without discovering some pathological condition to account for the failure. Many relapses occurring in later years are attributable to failure of development of the acetabular roof.

Gill advocates the shelf operation for those cases in which bloodless reduction is not successful but delays operation until the child has passed the age of five.

The question may be raised whether bloodless reduction is worth while in view of the above statistics. Answering it, Gill calls attention to the fact that 16 per cent of the total number of his patients and 30 per cent of those in whom the end-result was observed for eight or more years have stable painless hips and lead normal lives. In addition, 19 per cent enjoyed normal function for from five to twenty years before operation became necessary, while in others primary reduction of the hip made possible a successful shelf operation. Without primary reduction all operative procedures in later years are solely palliative, without restoration of normal function.

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SAN DIEGO ROENTGEN SOCIETY

Largely through the efforts of Dr. Harry A. Keener, Senior Medical Officer in Roentgenology at the Naval Hospital, there has recently been organized a San Diego (California) Roentgen Society for local radiologists and service men. The Society meets on the first Wednesday of each month for dinner and a case seminar. Dr. Henry L. Jaffe, of Chicago, now stationed at the Naval Hospital, Balboa Park, is secretary.

Letter to the Editor

DYSCHEZIA AND MEGACOLON

To the Editor

Dear Sir:

I appreciate your courtesy in submitting to me the proof of the paper on *Dyschezia and Megacolon* by Sir Arthur Hurst, which is to appear in the February issue of RADIOLOGY, thus giving me an opportunity to defend my position.

In reply to Hurst's statement that there had never been any confusion between the two conditions until my colleagues and I introduced it, and to the further charge that we had apparently not read any of the "numerous papers" which have appeared on the subject, I would like first of all to remind him that he fails to state what these "numerous papers" are. His bibliography consists of but seven references, including one to a paper which he has only recently published. The fact that he gives no evidence of having covered the literature sheds an important light on some of the conclusions he attempts to draw as he proceeds with his argument. While I make no claim to have exhausted the resources of the local libraries in reinforcing my conclusions, I did list thirty of the references I consulted, which I should regard as a minimum for exploring a subject as intricate as that of megacolon.

Hurst starts out by saying that normal defecation depends on a "conditioned reflex"—in which getting up, taking a bath, dressing, breakfast, reading a newspaper, and smoking a pipe all participate—and would have us believe that the establishment of such a reflex is of great importance in normal bowel habit. He then goes on to say that "in most cases of dyschezia this conditioned reflex is unimpaired, but"—and the italics are mine—"*for various reasons* it is not followed by the defaecation reflex proper, in which the rectum contracts and the anal sphincter relaxes, so that the rectum is found to be packed with faeces at whatever hour it is examined."

He continues by describing the manner in which the defecation reflex fails to function, because of failure to heed it, and pictures an individual who is becoming increasingly distressed by symptoms of pressure from a dilated and distended rectum, though he points out at the same time that normal sensation has become so impaired that the call to defecate is neglected. These conflicting statements would seem to reach the height of confusion.

I have objected to the term dyschezia as failing to represent a clinical entity, just as pain in the chest or fever cannot be said to represent such an entity. For my critic's conception of dyschezia, we may examine some of his published statements. In the section on "Constipation" in French's *Differential Diagnosis*—in many respects an excellent textbook—Hurst writes: "Fibrous stricture of the rectum is an occasional cause of dyschezia, especially in women . . ." and again: "Cancer of the rectum or pelvic colon is a grave cause of dyschezia . . . ." I still insist that he is not talking about a clinical entity.

I wish particularly to draw attention to the illustration on page 159 of French's book (Fourth Edition). Here Hurst pictures a condition which is essentially the same as the one illustrated in my article to which he takes exception. The rectal ampulla and lower sigmoid are dilated far beyond the degree which could occur in a normal person who had merely neglected emptying the bowel on occasion. There can be no question about that. Furthermore, the patients who are the subjects of such a condition have exhausted every means in their power to empty the rectum. They have employed cathartics and enemas, and finally consulted a physician. Hurst labels this illustration "Dyschezia in a boy of 10, associated with chronic inflammation of a tender pelvic appendix . . . ." (More confusion!) There can be no question that this illustration and that in my own paper *both represent instances of segmental megacolon.*

Hurst next turns to the subject of megacolon, stating that the condition is rare in children. Here he is at variance with all published material on the subject, as megacolon is universally recognized as first making its appearance in childhood, save for those exceptional cases in which disease or injury of the nervous system may have produced something like it in later life. That Hurst sees the condition most often in adults may be due to the fact that some of his patients did not consult a physician until they were fully grown.

As to pathogenesis, he states: "I believe that the primary factor in the pathogenesis of all cases of megacolon is achalasia of the sphincter ani . . . . This is sufficient to prevent the easy evacuation of faeces, which are consequently retained." Now, having given us a brave start in this direction, he goes on

to the symptoms, stating: "Digital examination of the rectum is painless; the *anal canal offers no more than the normal bowel resistance*"—again the italics are mine—"and there is no hypertrophy of the sphincter." Confusion?

When he comes to the matter of treatment, Hurst writes: "The main object in the treatment of megacolon is to lessen the resistance of the closed anal sphincter to the passage of faeces and gas." After stating that sympathectomies have been done with good results in boys but not in adults, he adds: "but equally good results could be very much more simply attained by local treatment." Is that statement intended to imply that all that has been claimed by neurosurgeons for the results of early sympathectomy has been in error, and that they have wholly overlooked the fact that some rectal dilatations could have given equally good results?

Incredibly enough, Hurst concludes with this statement: "It seems likely that the improvement following sympathectomy was really the result of the spinal anesthetic used for the operation or for diagnostic purposes. In any case there is now no excuse for performing sympathectomy, but a spinal anesthetic should be used in place of general anesthesia when difficulty is experienced in emptying the rectum and pelvic colon by enemas alone." May I point out that the effect of a spinal anesthetic is not a permanent one, that the blocking of certain nerve impulses lasts only as long as the anesthesia, and that such a procedure cannot replace the permanent interruption of certain nerve pathways such as may be achieved by their surgical removal?

In closing I reiterate the plea made in the original article, that the term "rectal dyschezia" be relegated to the niche in medicine where it belongs, along with laudable pus, the Lister spray, and the fallen stomach.

PERCY J. DELANO, M.D.
40 East Oak St.
Chicago, Ill.

In Memoriam

LESTER WHITE BAIRD

The death of Capt. Lester W. Baird, of coronary sclerosis, occurred on Oct. 6, 1943, at Camp Carson, Colorado Springs, Colorado.

Doctor Baird was born on April 19, 1907, in Edwardsville, Ill., the son of Henry N. Baird and Maude White Baird. He was graduated from the Edwardsville High School and obtained his M.D. from the University of Illinois in 1932, after which he spent two years, as intern and resident, at the Santa Clara County Hospital, San Jose, Calif. He had a three-year Fellowship in Radiology at the Mayo Clinic, and obtained the degree of Master of Science in Radiology from the Graduate School of the University of Minnesota. Leaving the Mayo Clinic in December 1936, he became radiologist at the Scott & White Clinic and the Santa Fe Hospital in Temple, Texas, where he remained until he entered the Army as a Captain in the Medical Corps, in November 1942. He was stationed at Camp Carson as head of the Radiological Department from that time until his death.

Doctor Baird was a member of the Bell County Medical Society, the Texas State Medical Society, and the Radiological Society of North America. He was a diplomate of the American Board of Radiology and a member of the American College of Radiology. He served as secretary of the Texas Radiological Society in 1941–42. He was a member of the Phi Beta Pi medical fraternity.

Doctor Baird had written scientific papers and appeared on the programs of local, state and national organizations. He conducted a refresher course in Carcinoma of the Colon for members of the Radiological Society of North America at their annual meeting in California in December 1941.

C. A. STEVENSON, M.D.

Book Review

THE ARTHROPATHIES: A HANDBOOK OF ROENTGEN DIAGNOSIS. By ALFRED A. DE LORIMIER, A.B., M.A., M.D., Colonel, Medical Corps, United States Army; Commandant, The Army School of Roentgenology, Memphis, Tenn. Formerly Director, Department of Roentgenology, Army Medical School, Washington, D. C. A volume of 319 pages with 678 figures. Published by The Year Book Publishers, Inc., Chicago, 1943. Price $5.50.

This volume by the head of the U. S. Army School of Roentgenology is the first of a new series of handbooks of roentgen diagnosis which will cover the various systems of the body. It is in the form of an atlas, presenting essential information in a highly condensed style. There are abundant illustrations with many full page plates.

In the introduction Colonel de Lorimier discusses basic factors of technic in the demonstration of soft tissues as well as osseous structures. He then outlines the studies to be made of the various structures of the joints and the correlation of the clinical history to the end that a more exact roentgen diagnosis may be made. In subsequent chapters the arthropathies are described individually, in outline form, with identical headings, which greatly facilitate comparison of particular features of different diseases. Under each condition are given the synonyms, direct roentgen criteria, incidence, history, physical and laboratory findings, and clinical course. A bibliography follows each chapter.

This book is recommended for students of roentgenology and roentgenologists not as an exhaustive treatise on arthritis but for a concise and orderly summary of the arthritides.

RADIOLOGICAL SOCIETIES OF NORTH AMERICA

Editor's Note.—Will secretaries of societies please cooperate by sending information to Howard P. Doub, M.D., Editor, Henry Ford Hospital, Detroit 2, Mich.

UNITED STATES

Radiological Society of North America.—Secretary, D. S. Childs, M.D., 607 Medical Arts Building, Syracuse, N. Y.

American Roentgen Ray Society.—Secretary, Harold Dabney Kerr, M.D., Iowa City, Iowa.

American College of Radiology.—Secretary, Mac F. Cahal, 540 N. Michigan Ave., Chicago, Ill.

Section on Radiology, American Medical Association.—Secretary, J. T. Murphy, M.D., 421 Michigan St., Toledo, Ohio.

ARKANSAS

Arkansas Radiological Society.—Secretary, J. S. Wilson, M.D., Monticello. Meets every three months and annually at meeting of State Medical Society.

CALIFORNIA

California Medical Association, Section on Radiology.—Secretary, Earl R. Miller, M.D., University of California Hospital, San Francisco, Calif.

Los Angeles County Medical Association, Radiological Section.—Secretary, Donald R. Laing, M.D., 65 N. Madison Ave., Pasadena. Meets second Wednesday of each month at County Society Building.

Pacific Roentgen Society.—Secretary, L. Henry Garland, M.D., 450 Sutter St., San Francisco. Meets annually during meeting of California Medical Association.

San Diego Roentgen Society.—Secretary, Henry L. Jaffe, M.D., Naval Hospital, Balboa Park, Calif. Meets first Wednesday of each month.

San Francisco Radiological Society.—Secretary, Sydney F. Thomas, M.D., San Francisco Hospital. Meets monthly on third Thursday at 7:45 P.M., in Toland Hall, University of California Hospital.

COLORADO

Denver Radiological Club.—Secretary, Edward J. Meister, M.D., 366 Metropolitan Bldg. Meetings third Friday of each month at the Denver Athletic Club.

CONNECTICUT

Connecticut State Medical Society, Section on Radiology.—Secretary, Max Climan, M.D., 242 Trumbull St., Hartford. Meetings bimonthly, on second Thursday.

FLORIDA

Florida Radiological Society.—Acting Secretary, Walter A. Weed, M.D., 204 Exchange Building, Orlando.

GEORGIA

Georgia Radiological Society.—Secretary-Treasurer, James J. Clark, M.D., 478 Peachtree St., N. E., Atlanta. Meetings twice annually, in November and at the annual meeting of State Medical Association.

ILLINOIS

Chicago Roentgen Society.—Secretary, Warren W. Furey, M.D., 6844 S. Oglesby Ave. Meets at the Palmer House, second Thursday of October, November, January, February, March, and April

Illinois Radiological Society.—Secretary-Treasurer, William DeHollander, M.D., St. Johns' Hospital, Springfield. Meetings quarterly by announcement.

Illinois State Medical Society, Section on Radiology.—Secretary, Fay H. Squire, M.D., 1753 W. Congress St., Chicago.

INDIANA

The Indiana Roentgen Society.—Secretary-Treasurer, Harold C. Ochsner, M.D., Methodist Hospital, Indianapolis. Annual meeting in May.

IOWA

The Iowa X-ray Club.—Holds luncheon and business meeting during annual session of Iowa State Medical Society.

KENTUCKY

Kentucky Radiological Society.—Secretary-Treasurer, Sydney E. Johnson, M.D., Louisville City Hospital, Louisville. Meeting annually in Louisville, third Saturday afternoon in April.

LOUISIANA

Louisiana Radiological Society.—Secretary-Treasurer, Johnson R. Anderson, M.D., North Louisiana Sanitarium, Shreveport. Meets annually at same time as State Medical Society.

Shreveport Radiological Club.—Secretary-Treasurer, R. W. Cooper, 940 Margaret Place. Meetings monthly on the second Wednesday, at the offices of the various members.

MARYLAND

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MICHIGAN

Detroit X-ray and Radium Society.—Secretary-Treasurer, E. R. Witwer, M.D., Harper Hospital, Detroit. Meetings first Thursday of each month from October to May, inclusive, at Wayne County Medical Society club rooms, 4421 Woodward Ave., Detroit.

Michigan Association of Roentgenologists.—Secretary-Treasurer, E. M. Shebesta, M.D., 1429 David Whitney Bldg., Detroit. Meetings quarterly by announcement.

MINNESOTA

Minnesota Radiological Society.—Secretary, John P. Medelman, M.D., 572 Lowry Medical Arts Bldg., St. Paul. Meetings quarterly.

MISSOURI

Radiological Society of Greater Kansas City.—Secretary, Arthur B. Smith, M.D., 306 E. 12th St., Kansas City, Mo. Meetings last Thursday of each month.

The St. Louis Society of Radiologists.—Secretary, Paul C. Schnoebelen, M.D., 462 N. Taylor Ave. Meets on fourth Wednesday of each month except June, July, August, and September, at a place designated by the president.

NEBRASKA

Nebraska Radiological Society.—Secretary, F. L. Simonds, M.D., 1216 Medical Arts Bldg., Omaha. Meetings third Wednesday of each month at 6 P.M. in either Omaha or Lincoln.

NEW ENGLAND

New England Roentgen Ray Society (Maine, New Hampshire, Vermont, Massachusetts, and Rhode Island).—*Secretary,* Hugh F. Hare, M.D., Lahey Clinic, Boston, Mass. Meets monthly on third Friday at Boston Medical Library

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Radiological Society of New Jersey.—Secretary, H. J. Perlberg, M.D., Trust Co. of New Jersey Bldg., Jersey City. Meetings at Atlantic City at time of State Medical Society and midwinter in Newark as called by president.

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Brooklyn Roentgen Ray Society.—Secretary-Treasurer, Leo Harrington, M.D., 880 Ocean Ave. Meetings held the fourth Tuesday of every month, October to April.

Buffalo Radiological Society.—Secretary-Treasurer, Joseph S. Gianfranceschi, M.D., 610 Niagara St. Meetings second Monday evening each month, October to May, inclusive.

Central New York Roentgen Ray Society.—Secretary-Treasurer, Carlton F. Potter, M.D., 425 Waverly Ave., Syracuse. Meetings are held in January, May, and October, as called by Executive Committee.

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Rochester Roentgen-ray Society.—Secretary, S. C. Davidson, M.D., 277 Alexander St. Meetings at convenience of committee.

NORTH CAROLINA

Radiological Society of North Carolina.—Secretary-Treasurer, Major I. Fleming, M.D., 404 Falls Road, Rocky Mount. Meeting with State meeting in May, and meeting in October.

NORTH DAKOTA

North Dakota Radiological Society.—Secretary, L. A. Nash, M.D., St. John's Hospital, Fargo. Meetings by announcement.

OHIO

Ohio Radiological Society.—Secretary, J. E. McCarthy, M.D., 707 Race St., Cincinnati. The next meeting will be held at the time and place of the annual meeting of the Ohio State Medical Association.

Cleveland Radiological Society.—Secretary-Treasurer, Don D. Brannan, M.D., 11311 Shaker Blvd., Cleveland 4. Meetings at 6:30 P.M. on fourth Monday of each month from October to April, inclusive.

Radiological Society of the Academy of Medicine (Cincinnati Roentgenologists).—*Secretary-Treasurer,* Samuel Brown, M.D., 707 Race St. Meetings held third Tuesday of each month.

PENNSYLVANIA

Pennsylvania Radiological Society.—Secretary-Treasurer, L. E. Wurster, M.D., 416 Pine St., Williamsport. The Society meets annually.

The Philadelphia Roentgen Ray Society.—Secretary, Robert P. Barden, M.D., 3400 Spruce St., Philadelphia. Meetings held first Thursday of each month at 8:15 P.M., from October to May, in Thomson Hall, College of Physicians, 21 S. 22nd St., Philadelphia.

The Pittsburgh Roentgen Society.—Secretary-Treasurer, Reuben G. Alley, M.D., 4800 Friendship Ave., Pittsburgh, Pa. Meetings are held on the second Wednesday of each month at 4:30 P.M., from October to June, at the Pittsburgh Academy of Medicine, 322 N. Craig St.

ROCKY MOUNTAIN STATES

Rocky Mountain Radiological Society (North Dakota, South Dakota, Nebraska, Kansas, Texas, Wyoming, Montana, Colorado, Idaho, Utah, New Mexico).—*Secretary,* A. M. Popma, M.D., 220 North First St., Boise, Idaho.

SOUTH CAROLINA

South Carolina X-ray Society.—Secretary-Treasurer, Robert B. Taft, M.D., 103 Rutledge Ave., Charleston. Meeting in Charleston on first Thursday in November, also at time and place of South Carolina State Medical Association.

TENNESSEE

Memphis Roentgen Club.—Chairmanship rotates monthly in alphabetical order. Meetings second Tuesday of each month at University Center.

Tennessee Radiological Society.—Secretary-Treasurer, J. Marsh Frère, M.D., 707 Walnut St., Chattanooga. Meeting annually with State Medical Society in April.

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Texas Radiological Society.—Secretary-Treasurer, Herman Klapproth M.D., Sherman.

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Virginia Radiological Society.—Secretary, E. Latané Flanagan, M.D., 215 Medical Arts Bldg., Richmond.

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Washington State Radiological Society.—Secretary-Treasurer, Thomas Carlile, M.D., 1115 Terry Ave., Seattle. Meetings fourth Monday of each month, October through May, at College Club, Seattle.

WISCONSIN

Milwaukee Roentgen Ray Society.—Secretary-Treasurer, C. A. H. Fortier, M.D., 231 W. Wisconsin Ave., Milwaukee. Meets monthly on second Monday at the University Club.

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La Société Canadienne-Française d'Eléctrologie et de Radiologie Médicales.—General Secretary, Origène Dufresne, M.D., Institut du Radium, Montreal. Meetings are held the third Saturday of each month, generally at the Radium Institute, 4120 East Ontario Street, Montreal; sometimes, at homes of members.

CUBA

Sociedad de Radiología y Fisioterapia de Cuba.—Offices in Hospital Mercedes, Havana. Meetings are held monthly.

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ROENTGEN DIAGNOSIS

THE HEAD AND NECK

Note on the Identification of Skulls by X-ray Pictures of the Frontal Sinuses. Arthur Schuller. M. J. Australia **1:** 554–556, June 19, 1943.

The most striking feature of the roentgenographic appearance of the pneumatic spaces of the skull is the individual variation in size and configuration.

The frontal sinuses develop as extensions from the nasal cavities and are clearly seen in the second year of life. They grow slowly until puberty and then increase rapidly until the twentieth year. They are absent in about 5 per cent of adults studied roentgenographically; unilateral absence is seen in 1 per cent. Persistence of the frontal suture, demonstrable on postero-anterior roentgenograms, is often combined with absence of the frontal sinuses. Persistence of this suture is most frequent in Europeans (8.7 per cent) and least in Negroes (1.2 per cent) and Australian aborigines (1 per cent). The sinuses do not pass over the mid-line in these cases because of the thick central plate.

In female skulls the arcades of the scalloped upper border are smaller and more numerous than in the male. Pneumatic cavities of the skulls of identical twins are similar, but not identical. Thinning of the walls of the frontal sinuses in the elderly is due to a compensatory enlargement associated with shrinking of the frontal lobes of the brain. Occasionally, in the senile skull, a cavity may be formed due to atrophy of the diploe, communicating with the frontal sinuses. Hyperostosis frontalis may also produce changes in the size and shape of these sinuses.

Constitutional and hormonal factors may cause either hypopneumatization or hyperpneumatization. In cretinism the pneumatization is poor and in acromegaly the sinuses are often very large. Large frontal sinuses are seen in microcephalia, probably compensating for the hypoplasia of the brain.

Obstruction of the frontonasal duct due to inflammatory processes, injuries, or new growths may cause enlargement of the frontal sinuses. Acute or chronic inflammations tend to decrease the density of the compact lamina which outlines the cavity. Abnormalities of the frontal sinuses are seen in Paget's disease, osteofibrosis cystica, leontiasis ossea, osteoma, and osteosarcoma of the frontal bone.

A method is presented of describing the configuration and measuring the extension of the frontal sinuses in roentgenograms of skulls taken in the standard forehead-nose position, for the purpose of anthropometric identification by comparison with x-ray pictures formerly taken. DONALD R. LAING, M.D.

Spina Bifida and Cranium Bifidum: Unusual Nasopharyngeal Encephalocele. Franc D. Ingraham and Donald D. Matson. New England J. Med. **228:** 815–820, June 24, 1943.

This is an extensive and complete case report of multiple congenital deformities in a child, with attention centered about the protrusion of brain tissue into the nasal cavity. Roentgen studies showed absence of normal bone structures in the region of the cribriform plate and obliteration of most of the ethmoid cells. There were also harelip and cleft palate, through which the protruding brain tissue could be seen. Intracranial removal and repair of the defect were accomplished with excellent result. JOHN B. MCANENY, M.D.

Spina Bifida and Cranium Bifidum: Arnold-Chiari Malformation: Study of 20 Cases. Franc D. Ingraham and H. William Scott, Jr. New England J. Med. **229:** 108–114, July 15, 1943.

The Arnold-Chiari malformation is characterized by a congenital elongation of the cerebellum and brain stem into the cervical spinal canal. Penfield and Coburn (Arch. Neurol. & Psychiat. **40:** 328, 1938) believed it to be due to downward traction on the brain stem in embryonic life as a result of fixation of the cord at the site of a meningocele. Cases resembling the malformation described by Arnold and Chiari have, however, been reported without an associated spina bifida meningocele, which would suggest the possibility of some other mechanism.

The authors studied a series of 20 cases of this malformation, in 19 of which autopsy reports were available. The patients ranged in age between 2 days and 18 months. Meningocele was present in all.

The pathological process constantly found was exactly that originally described by Arnold—a prolongation of two tongue-like processes from the inferior poles of the cerebellar hemispheres through the foramen magnum and closely applied to the posterior surface of the medulla. Between one-half and two-thirds of the medulla was below the level of the foramen magnum and was elongated, narrowed, and compressed in its anteroposterior diameter. The fourth ventricle was elongated and flattened, and its lumen almost obliterated. The foramina of Magendie and Luschka lay below the level of the foramen magnum and were identified with difficulty. The upper cervical roots were found to run upward rather than downward, as is their normal course.

Spina bifida and myelomeningocele were present in all 20 cases, and dense fibrous adhesions were found binding the myelomeningocele to the vertebral defect.

Internal hydrocephalus was present in all cases. This may result in one of several ways: mechanical obstruction of the fourth ventricle or foramina of Magendie and Luschka; obliteration of the subarachnoid space by pressure of the herniated hindbrain while the fourth ventricle remains intact; aseptic inflammation and plastic exudate in the subarachnoid space from pressure irritation.

All cases showed microgyria. Craniolacunia was present in 15 cases and may have been present in the other 5. Hydromyelia occurred in 8 cases. Platybasia was seen 3 times and the Klippel-Feil syndrome was encountered once. JOHN B. MCANENY, M.D.

Roentgen Diagnosis of Malignant Nasopharyngeal Tumors. W. George Belanger and Cornelius G. Dyke. Am. J. Roentgenol. **50:** 9–17, July 1943.

Fourteen cases of malignant nasopharyngeal tumor were studied by the authors. Tumors in this area grow downward into the lumen of the nasopharynx and upward toward the base of the skull. Osseous changes consist of both proliferation and destruction, but only two cases in the present series exhibited proliferation. Destruction of one or more structures in

the base of the skull is the key to the roentgen diagnosis of these tumors. The three structures most frequently involved were: (1) the body of the sphenoid bone, (2) the basi-occiput, and (3) the medial margin of the great wing of the sphenoid bone. The apex of the petrous portion of the temporal bone and the foramina ovale and spinosum were involved less frequently. Stereoscopic roentgenograms taken in the basal position are of utmost importance. Study of the lateral roentgenogram, however, will often give a valuable clue and stimulate further study. Sometimes the osseous destruction is rapid, so that continued observation of a case under suspicion is advisable.

Soft-tissue changes are also of importance. They consist essentially of changes in the paranasal sinuses, manifested by clouding or sinusitis, and the presence of a mass either in the nasopharynx, the sphenoidal sinus, or both. In not a few of the cases seen by the authors, the roentgen diagnosis of nasopharyngeal cancer represented the first time that such a diagnosis of the patient's disease had been seriously considered. The importance of roentgenologic diagnosis is obvious when we consider the great difficulty of recognizing nasopharyngeal cancer clinically. By definitely establishing the diagnosis we may prevent unfortunate and useless surgical procedures. The only successful treatment of these tumors is by radiation therapy.

CLARENCE E. WEAVER, M.D.

Osteochondroma of the Coronoid Process of the Mandible. Richard T. Shackelford and Webster H. Brown. Surg., Gynec. & Obst. **77:** 51–54, July 1943.

The authors present two cases of osteochondroma of the coronoid process of the mandible, previous reports of which they have been unable to find in the literature. Both cases were in boys in their teens. The lesions which are described are similar in every respect to osteochondromas in general except for their unusual location on the coronoid process. The first case remained undiagnosed for several years, the nature of the lesion not having been recognized.

The authors list as the important points in diagnosis: slowly progressive, painless limitation of movement of the jaw in young persons, malocclusion in some cases, a bony-hard swelling in the region of the zygoma, and the abnormal bony projection demonstrable in roentgenograms taken from the proper angles.

Treatment consists of surgical removal of the growth. The authors' procedure consists in resection of the zygoma, after which the tumor is easily seen and resected. The zygoma is then replaced *in toto* or, if resected in sections, is replaced after threading on a stainless steel wire. The operative procedure was not followed by any disturbance of the facial or trigeminal nerves or of Stenson's duct, and the immediate and subsequent postoperative results were good.

ELLIS C. OSGOOD. M.D.

THE CHEST

Types of Lung Diseases Encountered in an Army Camp. Morris C. Thomas. Am. Rev. Tuberc. **48:** 1–7, July 1943.

A brief résumé of the types of lung diseases encountered in a large army camp is presented. Cases of definite tuberculosis are few in number due to the rigid standards employed for the induction examination. The majority of cases found are discovered on routine chest films taken for varied reasons rather than because of the presence of suggestive or definite symptoms.

Bronchiectasis is a more common disease than tuberculosis, probably because, except in the well advanced stages, it cannot be diagnosed at the induction centers so easily or accurately as can tuberculosis. About one-fourth of the patients are admitted to the hospital because of suggestive symptoms. In the others the condition is suspected from routine films usually because of slow convalescence from a respiratory infection or from a supposed pneumonia. Since the symptoms are unreliable and may be misleading, the policy has been adopted of doing iodized oil instillations on all men who show abnormal basal markings, shifting of the heart, or delayed resolution of a pneumonia.

Pneumonias account for the largest group of major pulmonary infections. Pneumococcic pneumonia forms only a small group. Most of the cases of pneumonia belong to the group reported officially as bronchopneumonia, atypical pneumonia, or pneumonia unclassified. This type of the disease was first encountered in February 1941. Since then it has undergone several changes both in its clinical manifestations and x-ray appearances. If the blood counts are used as criteria, two groups can be developed. Cases showing an initial leukocytosis may be classed as bacterial in origin and related to some type of bronchopneumonia. Those showing normal leukocyte counts may be grouped with the atypical or virus pneumonias. Such a differentiation, however, cannot be made clinically.

In general, soldiers are subject to the same diseases to be encountered in civilian life, and the cases seen are essentially of the same types anticipated in a comparable age group in civilian practice. Prompt hospitalization of the sick permits the study and observation of the early manifestations of many diseases. It has demonstrated that the accepted early symptoms are sometimes not "early." Observation of diseases under such controlled conditions emphasizes the fact that the clinical findings present in a given entity are neither fixed nor constant but are altered and varied by the individual's reaction to his infection.

L. W. PAUL, M.D.

Primary Atypical Pneumonia: Report of 200 Cases at Fort Eustis, Virginia. Thomas A. Campbell, Paul S. Strong, George S. Grier, III, and R. J. Lutz. J. A. M. A. **122:** 723–729, July 10, 1943.

So-called atypical pneumonia is more correctly designated as an "acute bronchiolitis with associated atelectasis." In a review of 200 cases of this currently popular pulmonary entity, which the authors suggest has existed for many years, special emphasis is placed upon its epidemiology, pathology, and clinico-roentgenological aspects.

It is pointed out that the disease occurs both endemically and in minor epidemics, the latter appearing largely in late fall or early winter months. The incubation period is between seven and twenty-one days and, while the condition is not highly contagious, prolonged contact results in a high incidence.

Roentgenologically, 81 per cent of the pulmonary lesions were basilar. These were characterized by a streaking type of density which radiated downward from the hilum and extended outward over the diaphragmatic dome. Superimposed on the stringy density was a mottled density, which was seen most

frequently at the right median base and along the left heart border. The stringy density was interpreted as a manifestation of bronchitis and bronchiolitis, and the mottled shadows were thought to represent a lobular form of atelectasis. The evanescence and variability of the pulmonary lesions, plus the fact that 19 per cent of the patients had some mediastinal shift, elevation of diaphragm, or interspace narrowing, tended to support the presence of atelectasis.

Apical lesions had to be differentiated from tuberculosis, and compression atelectasis, which was frequently encountered at the lung bases, required proper evaluation. Pleural fluid was encountered in only 6 per cent of cases. As in pneumococcal pneumonia, the roentgen signs of resolution in atypical pneumonia tended to lag behind clinical improvement.

DEPARTMENT OF ROENTGENOLOGY
UNIVERSITY OF MICHIGAN (J. H.)

Fatal Case of Atypical Pneumonia with Encephalitis. Hector Perrone and Myron Wright. Brit. M. J. **2:** 63–65, July 17, 1943.

The author presents a rather detailed case history of a patient who had atypical pneumonia with encephalitis and came to autopsy, where the condition of the brain and meninges was apparent. Three other cases of atypical pneumonia are reported where the patients showed all the evidences of encephalitis but the outcome was not fatal. In introducing the subject, a few random comments are made as to the etiological features of virus pneumonia and its relation to psittacosis, lymphogranuloma inguinale, and other conditions. The x-ray findings are discussed and described as large consolidated areas consisting of numerous soft, coarse shadows.

In the fatal case reported the postmortem findings in the brain consisted of dark brown pigmented areas in the cerebrum without significant changes elsewhere. The pathological diagnosis was acute encephalitis. At the time of autopsy the pneumonic condition was beginning to subside. Q. B. CORAY, M.D.

Diagnosis of Virus Pneumonitis in Infancy. John L. Gedgoud. Nebraska M. J. **28:** 51–53, February 1943.

The author discusses the findings in 74 cases of virus pneumonitis in infancy reported by Adams (J. A. M. A. **116:** 925, 1941; J. Pediat. **20:** 405, 1942) and presents 2 fatal cases from the University Hospital, Omaha. In Adams' series the mortality was 15, which is in marked contrast to the low mortality observed in clinically recognized adult cases. Clinical signs in the 74 cases varied from cough without fever to cough, dyspnea, cyanosis, and high fever. Little was detectable on chest examination. The roentgenogram may reveal only an indefinite accentuation of lung markings or may show definite areas of consolidation. These cases do not respond to sulfonamide therapy.

The cases which the author reports show the errors which may be made before arriving at the correct diagnosis. One patient, a two-year-old girl, appeared at the dispensary with cough and hoarseness of three days' duration, preceded by a "slight cold." Physical examination revealed a reddened pharynx and tonsils and some fine râles scattered through both lungs. That evening dyspnea and rapid respiration developed. The respiratory embarrassment was thought to be due to asthma and treatment was instituted with no effect. Fluoroscopy showed a severe emphysema and a possible foreign body in the larynx. There was no consolidation. Bronchoscopy failed to reveal a foreign body or inflammation of the larynx or trachea, but did show the picture of acute asthmatic collapse. A tracheotomy was done. As the patient's condition became worse despite treatment, it was realized that the obstruction was peripheral and not asthmatic in nature and a tentative diagnosis of "capillary bronchiolitis" or virus pneumonitis was made. The child became progressively weaker and died three days after admission, the eighth day after the onset of cough. A roentgenogram of the chest on the day of death showed an obstructive emphysema and a smear from the tracheal exudate showed cytoplasmic inclusion bodies in epithelial cells, confirming the diagnosis of pneumonitis of virus origin.

The second patient was a six-month-old white girl, who was admitted on July 14, 1942, with a history of vomiting for two weeks and a weight loss of 5 pounds in the preceding month. During June she suffered periods of irritability, anorexia, and alternate constipation and diarrhea. On July 9 she had entered a local hospital with "blue hands and feet." Fluids by clysis and gavage feedings did not bring relief. The mother stated that a cough had been present almost continuously since a cold at two weeks of age.

Physical examination revealed a reddened pharynx, dull retracted ear drums, and a few fine râles in the left apex. Breath sounds and percussion notes were normal. The rectal temperature was 102°, pulse 148, respirations 24.

The admitting diagnosis was malnutrition resulting from a persistent recurring upper respiratory infection, with the possibility of a lipoid pneumonia. Fluid balance was restored and the patient put on gavage feedings. During the first week the temperature gradually came down to 100°, but the weight gain was not satisfactory and vomiting still occurred. Five days following admission, after a vomiting episode, cyanosis and intensification of a previously weak cough appeared. Loose râles were present throughout both lungs and it was thought that an aspiration of vomitus had resulted in an aspiration pneumonia. Respirations became more labored but remained between 24 and 40. Fluoroscopy on July 21 did not show a mediastinal shift and a roentgenogram revealed some hilar and peritruncal thickening, but no definite area of bronchopneumonia. On July 31, the cyanosis increased and respirations, 50 to 60 per minute, became more labored. A pharyngeal smear on Aug. 15 contained epithelial cells with cytoplasmic inclusion bodies. The patient died three days later.

Autopsy revealed distended lungs except for an area of consolidation involving three-fourths of the left upper lobe. All of the bronchi throughout both lungs contained purulent material, occluding their lumina. Microscopic sections of lung tissue were typical of the so-called virus pneumonia.

The author questions the significance of cytoplasmic inclusion bodies as an aid to diagnosis of "virus pneumonitis."

Statistical Data. New Cases of Tuberculosis Discovered by Case-Finding Surveys. Edited by Mary Dempsey. Am. Rev. Tuberc. **48:** 58–63, July 1943.

From available information, it seems probable that at least 12,000,000 men will have had chest x-ray studies by the end of 1943 in connection with examination for the Armed Forces of the United States. In addition,

the U. S. Public Health Service is simultaneously conducting on an intensive case-finding campaign among employees of certain war plants, as well as those in government departments, and estimates that approximately 2,000,000 of these workers will have been x-rayed by the end of the year. Careful estimates based on actual findings to date indicate that by the end of this year (1943) approximately 25,000 persons will have been found in need of hospitalization who in ordinary times would not have been suspected of having tuberculosis. This figure indicates the need for greatly increased sanatorium facilities. In the past the ratio of two beds per annual death has been accepted as the minimum standard for determining the adequacy of hospital facilities. Comparing the number of deaths in 1941 with all available beds, it is found that only 15 states and the District of Columbia met this minimum standard. Now that case-finding surveys are being made on a nation-wide scale never before contemplated, it is obvious that facilities must be provided to care for those cases in need of treatment which are being found in an earlier stage than was previously possible. A table is appended showing the total number of additional beds needed for the various states to meet the minimum standard and care for the additional cases which will have been diagnosed. L. W. PAUL, M.D.

Roentgenographic Surveys for Tuberculosis in Massachusetts and Their Importance to the Physician. Philip E. Sartwell. New England J. Med. **228:** 711–713, June 3, 1943.

In Massachusetts 2,000 men have been rejected for military service because of tuberculosis or suspected tuberculosis. Industrial organizations have also been requiring pre-employment chest roentgenograms to detect tuberculosis, and many colleges require x-ray examination of students.

In industrial surveys, conducted by the Massachusetts Department of Public Health, when a positive case is found the patient is referred to his physician, who determines the activity of the process and the necessity for sanatorium care and a search for contacts. If the case is an active one, he reports it to the Department of Health.

Serial roentgenograms are the most reliable test for determining the presence or absence of the disease in suspects and healed cases about which any doubt exists.

Primary infection is rarely seen in an active stage in adults but calcified foci are frequently defined. Pleurisy with effusion is not often found in surveys but evidence of old pleurisy may be detected. Many nontuberculous lesions are discovered, as are also cardiac lesions, bone deformities, and diaphragmatic abnormalities.

While public and voluntary agencies have assumed an increasingly important role in tuberculosis control, the initial diagnosis must in most cases still rest with the physician. Even when case-finding surveys initiate the attack on the disease, it must be carried to completion by the individual practitioner.

JOHN B. MCANENY, M.D.

X-Raying of School Personnel. R. R. Newell. California & West. Med. **59:** 48–49, July 1943.

The adult "open type" of tuberculosis is the form of the disease which is most dangerous from an epidemiological standpoint. Teachers, secretarial personnel, and janitors in the public schools comprise a group which may have open tuberculosis and constitute a source of infection for large numbers of susceptible children. Statistics show that 3 to 10 adults per 1,000 have tuberculosis of the adult type. At this rate, among 3,000 public school employees (the figure for San Francisco) between 10 and 30 potential spreaders of the disease may be expected.

The well known methods of roentgenological case finding and their comparative efficiency and cost are mentioned. A fluoroscopic survey in San Francisco's Chinatown revealed a rather high incidence of tuberculosis, but about 20 per cent of the cases were lost to follow-up. In such a group, a slightly lower efficiency may not be of first importance and may be offset by the decrease in expense. Among school personnel, however, there is little chance that any case will not be adequately followed, so that one must measure the increased cost of the more efficient method against the presumptive cost of one missed case whose continued presence in the school might easily mean the production of one or several instances of reinfection tuberculosis among the pupils.

MAURICE D. SACHS, M.D.

X-Raying of School Personnel. D. T. Proctor. California & West. Med. **59:** 49–51, July 1943.

No tuberculosis program is complete unless there is a 100 per cent examination of all school personnel. Most tuberculosis associations and boards of health seem to be of the opinion that such examinations should be compulsory, but requirements differ from state to state. Most favor a chest film as the minimum essential, to be interpreted by an approved group of roentgenologists and phthisiologists.

In Los Angeles County, California, from 1939 to 1942, inclusive, 5,526 school employees were x-rayed: 122 cases (2.2 per cent) of chronic tuberculosis were diagnosed, and 12 cases (0.2 per cent) of active disease.

The author is of the opinion that, in order to protect school children from tuberculosis, all school personnel should be certified free of the disease. They should therefore be x-rayed at least once. Re-examination on negative cases need not be done oftener than every five years unless clinical findings warrant an earlier examination. Follow-up of all tuberculosis cases should be under direct supervision of the health department and all reports should be kept confidential. In order to carry out such a program, legislation, as well as the backing of organized teachers, is necessary.

MAURICE D. SACHS, M.D.

Pulmonary Tuberculosis: Bacteriological Examinations Supplementing Routine Thoracic Radiography in the Australian Military Forces. Reginald Webster. M. J. Australia **2:** 61–67, July 24, 1943.

Bacteriological examinations were done on 1,548 members of the Australian Armed Forces who were suspected of pulmonary tuberculosis on the basis of radiographic evidence. The reason for this approach to the problem of tuberculosis lay in the prospect it offered of furnishing data upon which diagnosis by miniature radiography might be evaluated and also in the hope of gleaning facts regarding the number of tubercle bacillus "carriers."

The procedure followed requires the patient to report at 9 A.M. after eleven hours of fasting. If a satisfactory

sputum specimen is not obtained, a sample of the content of the fasting stomach is taken by means of a Rehfuss tube. The value of the mucus from the stomach is determined solely by the amount of bronchial mucus it contains. Not one of 59 women examined could furnish any sputum; yet there were 20 positive cultures from this group.

The routine laboratory diagnosis of tuberculosis based on cultural methods to the exclusion of animal inoculation may be criticized on the basis of the existence and occasional intrusion into cultures of acid-fast bacilli other than mammalian tubercle bacilli. Acid-fast saprophytes are often associated with butter and milk and may confuse the issue in the cultivation of tubercle bacilli from gastric contents. Past experience, however, has shown that such acid-fast saprophytes are not a serious source of error in well conducted laboratories.

Positive bacteriological findings were obtained in 364 cases. Of this number, only 65 were diagnosed by direct microscopic examination of the sputum; 107 by cultivation from specimens of sputum in which no acid-fast bacilli could be detected by microscopic search; 19 by microscopy of smears of the gastric content, and 173 by cultivation from the concentrate of the resting content of the stomach. The advantage of this last method is obvious.

In correlating the bacteriological results in relation to the radiological estimation of activity, the recruits were divided into four groups. Those declared roentgenographically to have "active pulmonary tuberculosis" totaled 505, and of these 53.8 per cent were positive. Gastric culture accounted for 118 of these. The second group comprised those of "doubtful activity." Out of 237 such cases, 14.3 per cent were positive (21 by the gastric culture method). The third classification of "pulmonary tuberculosis, old, healed, or inactive," radiographically, included 374 cases, of which 5.6 per cent gave a positive bacteriological diagnosis. The fourth group consisted of the "doubtfully tuberculous" and totaled 224. Of these cases, 9.3 per cent were positive bacteriologically.

These findings would indicate that the activity, quiescence, or healing of a tuberculous process cannot be determined radiographically on the basis of a single film, but must be based on serial roentgenographic studies and even then there are definite limitations, which must be bolstered by bacteriological examinations.

Unfortunately, an adequate bacteriological routine for the examination of tuberculous suspects tends to cause delay, which in the case of army administration may cause serious inconvenience. Positive bacteriological findings are generally determined in an average period of twenty-one to twenty-eight days, but a negative report cannot safely be made until the culture tubes have emerged sterile from at least six weeks' incubation.

DONALD R. LAING, M.D.

Importance of Wheeze in the Diagnosis of Pulmonary Tuberculosis. John S. Packard. Pennsylvania M. J. **46:** 1034–1041, July 1943.

Early symptoms of pulmonary tuberculosis are well known to both the physician and general public. Cough that persists, increasing fatigue, loss of appetite and weight, recurrent chest pains, and afternoon temperature elevation are symptoms that demand attention. The excellence of the x-ray examination for picking up early lesions is unquestioned. The five cardinal points of Dr. Lawrason Brown should be kept in mind: (1) persistent râles in the upper half of the chest; (2) parenchymatous roentgen lesion; (3) tubercle bacilli in the sputum; (4) history of unexplained hemoptysis of a teaspoonful or more; (5) history of unexplained pleurisy with effusion.

The presence of a wheeze has been considered a sign of asthma, foreign body, or lung tumor, but it has been the experience of the author that at least in a fair number of cases it is one of the first signs of pulmonary tuberculosis. Persistent wheeze in a known tuberculous patient demands a bronchoscopic study, the main reason being that tuberculous tracheobronchitis may cause serious obstruction if left untreated. Tuberculous tracheobronchitis may precede parenchymal lesions; in a series of 28 cases, 14.2 per cent showed no roentgen evidence of involvement of the parenchyma.

In differentiating the wheeze of tuberculosis from that of asthma, we find that the tuberculous wheeze is usually well localized over the area of involvement and is fairly constant. Tuberculous bronchitis is found more commonly in women than in men by a ratio of ten to one. Seven case histories are included.

JOSEPH T. DANZER, M.D.

Bronchiectasis Secondary to Pulmonary Tuberculosis. Arnold B. Rilance and Bruno Gerstl. Am. Rev. Tuberc. **48:** 8–24, July 1943.

A group of 47 tuberculous patients in whom bronchiectasis also was present forms the basis for this report. In 12 of these patients the bronchiectasis was found at autopsy. In the remaining 35, studies with iodized oil were made while patients were undergoing sanatorium treatment; of these, there were 3 in whom the bronchiectasis was felt to be independent of the tuberculous process and merely accidentally associated, while in the other 32 the bronchiectasis was considered a result of the tuberculosis. In these patients, with rare exceptions, the general appearance of the plain roentgenograms failed to demonstrate anything that might be considered unusual in ordinary chronic tuberculosis, the bronchiectatic process being masked by the tuberculous disease. Following instillation of iodized oil a moderate to marked degree of distortion and abnormal angulation of the bronchi was found in over one-half of the cases. The appearance suggested that the bronchi were being irregularly displaced out of the normal position by the pulmonary fibrosis in their vicinity. In most instances the location of the bronchiectasis and the area of major tuberculous involvement coincided. The individual cylindrical and fusiform dilatations showed nothing very unusual or different from what is seen in ordinary bronchiectasis.

It seems likely that suppurative bronchiectasis in tuberculous patients represents a specific pathological process due to tuberculosis, directly involving certain segments of the bronchial tree and differing from the benign dilatation that might be explained on the basis of pulmonary fibrosis. Once having developed, secondary changes due to the presence of pyogenic bacteria may determine the severity and the course the condition is to follow.

Bronchiectasis in tuberculosis, therefore, can be of two types. In the one it is merely a benign bronchial dilatation not associated with abnormality of bronchial function and producing few symptoms. In the other and smaller group a true suppurative bronchiectasis is

superimposed upon the tuberculosis and may overshadow the latter in its clinical aspect.

L. W. PAUL, M.D.

Liquefaction Necrosis in Bilateral Symmetrical Conglomerate Lesions of Anthraco-Silicosis of the Lung: Report of a Case. Bernard J. McCloskey. Am. J. Roentgenol. **50:** 42–45, July 1943.

The case reported here was that of a 63-year-old man who had worked as a pick miner in a soft coal mine for twelve years, from 1884 to 1896. No further exposure to silica had occurred up to the time of the patient's death from gastric cancer, forty-four years later. The roentgenogram of the chest taken one month before death showed a diffuse, uniform and irregular nodulation throughout the chest, except at the extreme apices. There was a conglomerate shadow in each subclavicular area. Autopsy showed liquefaction necrosis in large conglomerate lesions of anthracosilicosis not complicated by tuberculosis. This produced cavities filled with thick, viscid, black fluid. The roentgenologic appearance of the necrotic areas was that of consolidation or pleural thickening. Examination of the cavity fluid showed no free silica. The cavity wall and surrounding lung tissue had a content of 0.25 per cent silica. The lungs showed no metastasis from the gastric cancer.

CLARENCE E. WEAVER, M.D.

"Mitralization" of the Cardiovascular Silhouette in the Posteroanterior Roentgenogram. Robert Shapiro. Am. J. Roentgenol. **50:** 46–53, July 1943.

The term "mitralization," as applied to the cardiovascular silhouette in the postero-anterior projection has been widely used to indicate a straightening or convexity of the left upper heart border. In mitral stenosis the right ventricle enlarges upward and to the left, causing a straightening or even a convexity at the area of normal concavity of the left heart border. This appearance, however, is not confined to mitral stenosis. In the majority of instances, enlargement of the left auricular appendage does not seem to play an important role in the formation of the left upper heart border.

A "mitral type" of heart may be seen under certain physiological conditions. Roentgenograms taken in deep inspiration produce a pseudostraightening of the left heart border because of descent of the diaphragm. In the thin asthenic type of person with a long, narrow chest and low diaphragm, the heart may rotate in a clockwise direction so that the pulmonary artery is brought into more prominent relief; the left lower heart border takes a steeper course, and a straightening results. In many children the heart is globular, the left border being smoothly convex, giving the appearance of "mitral configuration." A prominent visible descending aorta may on casual inspection seem to produce an accentuated left upper heart border.

A variety of pathological conditions may also produce a straightening of the left heart border. Scoliosis of the dorsal spine to the right causes a rotation of the heart, bringing the pulmonary artery into more prominent relief. Change in contour of the heart also occurs as a result of funnel breast. Chronic diffuse pulmonary disease can bring about enlargement of the right side of the heart. This is probably chiefly due to resistance in the pulmonary circulation in conjunction with interference with the respiratory mechanism. Such right ventricular enlargement may occur in pneumoconiosis, emphysema, certain types of chronic pulmonary tuberculosis, pulmonary arteriolar sclerosis, and in nontuberculous bacterial disease. Enlarged hilar nodes and pleuropericardial adhesions may cause an appearance of straightening of the left heart border. The "mitral type heart" is sometimes seen in beriberi and hyperthyroidism.

While mitral stenosis is by far the most common pathological condition responsible for a straight upper left border of the heart shadow, it may occur, also, in association with other types of cardiac disease. Patent ductus arteriosus may give rise to enlargement of the pulmonary artery with straightening or convexity of the left upper heart border. Heart failure and pericardial effusion are other possible causes.

Because of the wide variety of conditions in which the phenomenon may occur, a roentgenologic diagnosis of mitral stenosis should rarely be made from the posteroanterior view alone; one should also have oblique views, especially the right anterior oblique view with barium paste in the esophagus to demonstrate the presence of left atrial enlargement. The roentgenologist should discard such ambiguous terms as "mitralization," "mitral type heart," "mitral configuration," etc., since they tend to be confusing and inaccurate.

CLARENCE E. WEAVER, M.D.

Roentgenologic Diagnosis of Right-Sided Enlargement of the Heart. M. L. Sussman, A. Grishman, and M. F. Steinberg. New England J. Med. **228:** 777–783, June 17, 1943.

Angiocardiographic studies were made in 270 patients following intravenous injection of 70 per cent diodrast. This report is concerned with the evaluation of criteria to determine right-sided cardiac enlargement.

Emphysema is usually considered as producing right-sided hypertrophy, but of 28 cases of this condition studied, only 10 showed enlargement, and in none did this exceed 10 per cent of the accepted normal. In several cases having the greatest degree of ventricular dilatation, the cardiac configuration was normal. This is explained by the bulge of the interventricular septum to the left. The left middle cardiac contour was prominent in some cases and prominence of the hilar vessels was noted in more.

It is apparent from angiocardiographic studies that the prominent middle left arc in mitral heart disease is not due to enlargement of the pulmonary conus and artery but to enlargement of the left auricle, especially the atrium.

In cor pulmonale the heart is enlarged in its transverse diameter, mainly to the left, with a bulge of the middle left segment, which is due to dilatation with tortuosity of the pulmonary artery.

This study shows that considerable right-sided enlargement may occur before it can be demonstrated in the conventional roentgenogram. As dilatation increases, there is enlargement of the transverse diameter to the left; later, when dilatation of the right auricle occurs, there is enlargement to the right and anteriorly.

JOHN B. MCANENY, M.D.

Dissecting Aneurysm of the Aorta. R. Bruce Logue. Am. J. M. Sc. **206:** 54–66, July 1943.

Dissecting aneurysm of the aorta is characterized by splitting of the media, in which cystic degeneration is frequently present. Hypertension is almost always associated, and although arteriosclerosis is invariably

an accompaniment, the tear is almost never in an atheromatous ulcer. Syphilis is thought to play no part in the etiology. Most cases are seen after the age of forty.

Dissecting aneurysms usually occur in the aorta or in one of its main branches, but have been reported in the pulmonary, cerebral, splenic, and thyroid arteries. A transverse tear usually occurs in the intima in the first few centimeters of the aorta, but may be located elsewhere. It seems quite likely that an intimal tear is secondary to hemorrhage into the media. The dissection may proceed upward or downward, stripping and occluding various arteries along the aortic trunk. If the dissected channel re-enters the lumen of the aorta, a so-called double-barreled aorta results. Localized buiging may occur; this is usually seen in the distal part of the arch and the beginning of the descending aorta. A rupture through the intrapericardial portion is followed by cardiac tamponade, the most common cause of death.

The pain, which may appear during exertion or rest, is sudden in onset, very severe, and may radiate to the head or to the back and legs. After a transient period of shock, the blood pressure returns to normal or, more often, to a high level. The heart is usually enlarged as a result of the pre-existing hypertension. Symptoms may be bizarre due to occlusion of the intercostal and lumbar arteries supplying the spinal cord, of the mesenteric or iliac arteries. Rumbling or blowing murmurs have been heard along the course of the aorta. In one case a murmur was heard along the femoral artery.

The course is usually short, although patients have been known to live for years and die of another disease. About 80 per cent die within a few days. After the first twenty-four hours a slight fever frequently develops. Signs of pleural effusion may appear. After a period of a few hours to days, death may ensue suddenly and without warning, as rupture occurs.

The electrocardiogram reveals no characteristic changes unless the coronary arteries are involved by the dissection.

Roentgenologically there may be widening of part or all of the aorta. The author describes a radiolucent area outside of the main shadow of the aorta as a characteristic sign and states that an organized clot is the source of this shadow. [The shadow indicated seems to be the pulmonary artery or a part of the slightly widened descending aorta.]

A series of 12 cases is tabulated and 3 cases are presented in detail. BENJAMIN COPLEMAN, M.D.

Radiological Changes in Carotid-Cavernous Aneurysm. R. A. Kemp Harper. Brit. J. Radiol. **16:** 150–152, May 1943.

Two cases of carotid-cavernous aneurysm are reported. Both showed unilateral erosion of the sella turcica, clinoid processes, and sphenoidal ridge, together with enlargement of the sphenoid fissure and optic foramen. In one patient the changes were of twenty years' standing. These findings have not been reported before. SYDNEY J. HAWLEY, M.D.

THE DIGESTIVE SYSTEM

Gastric Herniation at the Esophageal Hiatus. John W. Turner. Am. J. Roentgenol. **50:** 33–41, July 1943.

Hiatus hernia produces anginoid pain, worse after meals, aggravated by the horizontal position and frequently accentuated by emotional stress. Troublesome symptoms do not occur in all patients who present this abnormality.

In his discussion of the anatomical and physiological considerations which enter into the problem of hiatus herniation of the stomach, the author mentions the following significant facts. There is intimate proximity of the esophagogastric junction and the cardia of the stomach to the heart, lungs, and left lobe of the liver. It is significant that the nerve supply of the distal esophagus, both parasympathetic and sympathetic, is closely related to that of neighboring organs. Experimental work has shown that distention of a balloon in the distal portion of the esophagus of a normal person will produce definite anginoid pain.

Three factors, as reported by Eisen (Canad. M.A. J. **39:** 207, September 1938. Abst. in Radiology **32:** 257, February 1939), contribute to the greater frequency of this condition in females: pregnancy, high incidence of chronic constipation, and frequent postmenopausal obesity, all of which serve to increase intra-abdominal pressure. Pyrosis results from the retrograde passage of gastric contents into the terminal esophagus and, if repeated, may lead to esophageal peptic ulcer formation. Local esophageal spasm may also occur. Pain referable to the left shoulder may be present when there are adhesions to the left dome of the diaphragm.

Among 1,500 upper gastro-intestinal examinations, the incidence of hiatal hernia was 3.5 per cent. Frequently the clinical diagnosis was carcinoma and even more frequently coronary disease or gallbladder disease, but almost never peptic ulcer. As a general rule, these hernias are easier to demonstrate in their true extent with the patient supine, in slight Trendelenburg position. Having the patient alter pressures by the Valsalva effort and Müller effort, particularly the latter, may aid in diagnosis. To see gastric rugae traversing the hiatus suffices for a positive diagnosis of herniation. A gastric diverticulum will show absence of the rugal pattern.

Available evidence suggests that a mobile or sliding herniation is less likely to produce symptoms, while the fixed hernial sac, either because of a very small orifice or fibrous connective tissue bands or both, may cause considerable discomfort. A hernia showing limited distensibility and marked prominence of rugal pattern is most likely to produce symptoms. Dysphagia is rarely produced by this condition. Most cases occur in well nourished persons past middle age.

CLARENCE E. WEAVER, M.D.

A Radiological Sign of Pyloric Stenosis. A. S. Johnstone. Brit. J. Radiol. **16:** 169–170, June 1943.

If films are made with the patient supine and the left side raised a little, after a barium meal, it is often possible to demonstrate the thickness of the gastric wall. If this shows hypertrophy it is an indication that the pyloric obstruction is due to stenosis rather than spasm. SYDNEY J. HAWLEY, M.D.

Enterogenous Cyst of the Duodenum. Richard Orgias. Brit. J. Surg. **31:** 90–93, July 1943.

A case is reported of an infant with a history of frequent projectile vomiting. A smooth cystic tumor was palpable in the right half of the abdomen. A renal

tumor was excluded by excretory pyelogram. At operation, at the age of 7 weeks, a cyst 3 inches in diameter was found lying behind the transverse colon. It was attached to the inferior surface of the pylorus and first portion of the duodenum, which were stretched like a band across the cyst. The involved portion of the stomach and duodenum, bearing the cyst, was resected and an end-to-end anastomosis made. Recovery was uneventful and at six months the infant was normal in all respects. The pathological report was a developmental cyst arising as a diverticulum from the first portion of the duodenum. Microscopically the cyst wall contained all the components of the duodenum.

Nine cases of developmental enterogenous cysts arising in the duodenum were found in the literature, with 3 recoveries. With one exception, all of the patients were very young infants. One case is reported in a girl of 15 years with a long history of abdominal pain and vomiting.

These cysts are thought to originate as diverticula from the gut, the communication between the diverticulum and the intestine then becoming obliterated. The diagnosis depends on the presence of a large abdominal tumor which is unlike the small hard tumor found in hypertrophic pyloric stenosis. Successful results have been obtained from the following methods of treatment: (1) drainage of the cyst into the duodenum; (2) aspiration of the cyst followed by gastro-enterostomy; (3) resection and anastomosis.

MAX CLIMAN, M.D.

Enlargement of the Ileocecal Valve. Ross Golden. Am. J. Roentgenol. **50:** 19–23, July 1943.

The ileocecal valve is rarely large enough to produce a recognizable indentation in the shadow of the barium-filled cecum. Two cases are described in which the lips of the valve were enlarged. One showed a large defect about the ileocecal junction, interpreted as suggesting slight intussusception. At operation, hypertrophy of the lips of the ileocecal valve was found with edematous mucosa covering them, causing a bulging into the cecum. The terminal ileum was edematous. The author thinks it is quite probable the edema in this case was due to a nutritional deficiency from lack of vitamins. No other cause could be found. In the second case an area of diminished density around the ileocecal valve was present on the roentgenograms. The terminal ileum was not well seen. A shadow in the cecum was thought to be a polyp. Operation showed the presence of early regional enteritis. The ileal side of the ileocecal valve was edematous and pendulous, projecting into the cecum.

The demonstration of enlargement of the ileocecal valve by barium enema may be taken as a strong suggestion to look for regional enteritis by means of a small intestine study. Pressure roentgenograms of the ileocecal junction are to be highly recommended.

CLARENCE E. WEAVER, M.D.

Sigmoiditis. Stephen L. Casper. Am. J. Roentgenol. **50:** 24–31, July 1943.

Sigmoiditis is considered by the author to be a disease entity. Its incidence in a series of 489 barium enema studies was 2.6 per cent. Of the 13 patients, 11 were females and 2 males. Their age ranged from thirty-seven to seventy-five years. Spasticity and irritability of the sigmoid were obviously in excess of normal and were restricted to the distal end of the descending portion of the colon and the sigmoid. So far as is known, none of these patients has subsequently developed a more extensive or progressive colitis.

The outstanding symptom is pain, often dull and aching in character and usually limited to the lower abdomen, especially the left lower quadrant. Diarrhea or constipation may occur, either alone or alternately. The onset in several of the patients suggested disease of the urinary tract. Systemic symptoms were relatively mild. The most frequent tentative diagnosis was diverticulitis of the sigmoid. Uniform reduction in the caliber of the sigmoid, as well as shortening of this segment of the colon, may be a sequel to the disease.

Conditions to be differentiated are diverticulitis of the sigmoid, sigmoiditis secondary to pelvic inflammatory disease, inflammatory changes secondary to radiation therapy, endometrial implants, syphilitic involvement of the colon, chronic ulcerative colitis, tuberculosis, lymphogranuloma venereum, and cancer.

In the examination by barium enema roentgenoscopy is of paramount importance, The barium suspension is permitted to flow while the patient is placed in the supine and various oblique and lateral positions. It is preferable to make exposures while the opaque medium is still flowing. The enema should be given slowly and interrupted at intervals. While the flow may be retarded due to irritability, there is no obstruction. None of the cases showed any indication of mucosal ulceration.

Treatment consists of a low-residue diet, hot rectal irrigations of physiologic saline solution, and thorough atropinization with tincture of belladonna.

Case reports illustrated by roentgenograms are given.

CLARENCE E. WEAVER, M.D.

Lateral View in the Roentgenologic Diagnosis of Lesions of the Colon. Egon G. Wissing and Robert M. Lowman. New England J. Med. **229:** 207–210, July 29, 1943.

This is a plea for more extensive investigation of the colon by all means at one's command. There is full acknowledgment of prior advocacy of all the procedures described, but the need for their use is again emphasized.

The difficulty of defining a sigmoid lesion in the routine postero-anterior view is stressed, and the oblique and lateral exposures are advocated to demonstrate these areas more clearly in an attempt to eliminate the so-called blind-spot of the colon.

The authors advocate thorough preparation of the patient with 60 c.c. of castor oil and an evening colonic irrigation the day before examination and an enema on the morning of examination.

The barium enema is given under fluoroscopic control, with spot films as required. Postero-anterior and lateral views are then made. After evacuation, the patient is again studied fluoroscopically, air is injected if necessary, and again postero-anterior and lateral views of the colon are made.

Three illustrative case histories are presented with their roentgenographic demonstration.

JOHN B. MCANENY, M.D.

Intussusception of the Appendix. Kenneth Fraser. Brit. J. Surg. **31:** 23–33, July 1943.

Seventy-five cases of intussusception of the appendix are reviewed and 7 new cases are reported. Various

theories are offered to explain the development of this rare condition. Excessive peristalsis to extrude a concretion or polyp is considered a factor in a number of instances. Two-thirds of the cases occur in children due to increased lymphoid tissue in the terminal ileum and appendix. The lymphoid tissue acts as a foreign body and gives rise to irregular and increased peristalsis of bowel and appendix, sometimes culminating in intussusception. Other cases seem to be attributable to a nodule of inflammatory tissue developing at the base of the appendix, causing a buckling inward first of the mucosa and later of all its coats at the point of involvement. In a certain proportion of the cases it is probable that the intussusception has been preceded by an acute attack of appendicitis, which has left a thickening of the appendiceal wall at or near its base, so localized as to give rise to the foreign-body effect necessary to the onset of vigorous appendiceal peristalsis. Several cases of intussusception of the appendiceal stump have been reported following appendectomy and inversion of the stump.

Intussusception of the appendix into itself occurred only twice in the entire series considered by the author. In the vast majority of instances the process starts at the junction of the appendix with the cecum, so that the intussusception is formed by the base of the appendix prolapsing into the cecum. In a third of the cases the intussusception progressed and reached the ascending colon or further.

The clinical features in a simple intussusception are severe colicky pain in the mid-abdomen, and sometimes in the right iliac fossa, lasting a few minutes and followed by periods of complete well-being. Vomiting occurred in many cases; it was a more obvious feature in the compound type of intussusception with invagination of the ileocecal valve into the ascending or transverse colon or beyond. In the absence of rigidity of the abdomen a mass was frequently palpable in the right iliac fossa, slightly tender and usually mobile. X-ray examination may be of diagnostic value. A barium enema may reveal a filling defect in the cecum or failure of the cecum to fill.

Several possible lines of treatment are considered, suitable to the different types of intussusception encountered. Illustrations are included.

MAX CLIMAN, M.D.

THE BILIARY TRACT

Cholecystography: Correlation of the Roentgenological, Surgical, and Medical Findings in 355 Cases. Henry J. Walton and Charles N. Davidson. Southern M. J. **36:** 411–414, June 1943.

This paper presents a comprehensive study of the accuracy of cholecystographic interpretation. The findings of the authors in a series of 355 examinations are in close agreement with other published reports of large series of cases. Observers agree that a nondemonstrable gallbladder is diseased in well over 90 per cent of all cases and that extrabiliary factors in non-visualization are negligible.

Of the 355 cases reviewed here, 100 were subjected to surgery and the roentgenological, surgical, and pathological findings were correlated. The remaining 255 cases were treated medically, with similar correlation of biliary disease as found clinically and gallbladder function as observed roentgenologically. Oral cholecystography was the method generally employed.

In the surgical group the roentgenological findings were confirmed in 91 cases. Of 56 patients in whom visualization could not be obtained, 53 had unquestionable gallbladder disease; of 22 in whom function was found roentgenologically to be poor, 20 had gallbladder disease, confirmed pathologically; while of 22 in whom function was found unimpaired, 18 had normal gallbladders.

In the medically treated group, 88.7 per cent of the cholecystographic findings were corroborated by a clinical diagnosis of cholecystic disease. Of the 255 patients, 185 had normally functioning gallbladders, 44 had poorly functioning gallbladders, and 26 had nonfunctioning gallbladders. Of the 185 reported as having normal function, 163 had no clinical evidence of biliary disease, 6 had a definite diagnosis of biliary disease, 9 had a diagnosis of possible biliary disease, and 7 had a final diagnosis of catarrhal jaundice. Of the 44 patients with poorly functioning gallbladders, 34 had diagnoses of gallbladder disease, 2 had a possible diagnosis of gallbladder disease, 5 had no diagnosis referable to the biliary tract, 2 had cirrhosis of the liver, and 1 catarrhal jaundice.

In the 26 cases with a report of non-functioning gallbladders a diagnosis of cholecystitis was made in 21 instances. The remaining 5 cases were diagnosed as cirrhosis of the liver, catarrhal jaundice, cholangitis, syphilitic hepatitis, and acute hepatitis.

MAX MASS, M.D.

THE SPLEEN

Single True Cysts of the Spleen: Report of 3 Cases. Richard H. Sweet. New England J. Med. **228:** 705–710, June 3, 1943.

Cysts of the spleen are classified as true and false. True cysts comprise about 21 per cent of the total and are distinguished from the false cysts by being lined by a specific secreting membrane. Three complete case reports of true cysts are presented.

The diagnosis is not too difficult. There is a large left upper quadrant abdominal tumor, raising the left costal margin and showing a resilient quality on palpation and usually a detectable fluid wave. The roentgen picture is characteristic. The large abdominal tumor raises the left half of the diaphragm, which shows impaired motion. The lower pole of the mass has a somewhat pointed or angular contour and may extend into the pelvis. The stomach is displaced to the right and possibly posteriorly. The colon is displaced inferiorly and to the right. The left kidney is displaced downward. The combination of the physical and roentgen observations is sufficiently characteristic to be diagnostic.

Treatment is by splenectomy. It is surprising how rapidly the displaced organs return to normal after the tumor is removed.

JOHN B. MCANENY, M.D.

THE SKELETAL SYSTEM

Evolution of the Circulation in the Developing Femoral Head and Neck: An Anatomic Study. W. Eugene Wolcott. Surg., Gynec. & Obst. **77:** 61-68, July 1943.

The author summarizes his earlier studies of the circulation in the adult femoral head and neck as follows:

1. The ligamentum teres carries at least one main artery which penetrates the head of the femur and

anastomoses with vessels entering the head by way of the visceral capsule in approximately 80 per cent of adult specimens.

2. In about 20 per cent of adult specimens the ligamentum teres vessels failed entirely to enter the femoral head.

3. The uniformity of size and area of distribution of vessels within the femoral head led to the conclusion that it was adequate to nourish a greater portion of the head of the femur in cases in which the artery actually penetrated the substance of the head.

4. The visceral capsule never failed to carry two groups of arteries, usually three to four in number, which entered the neck of the femur just distal to the subcapital area, traveling directly toward the center of the femoral head, where they anastomosed with the terminal branches of the nutrient artery of the shaft and the ligamentum teres vessels. These two groups of arteries lie within the superior posterior quadrant and inferior posterior quadrant of the visceral capsule. The anterior portion of the visceral capsule contains no arteries of importance. The capsular arteries are the major source of blood going to the head and neck of the femur and arise from the median circumflex artery.

5. A small branch of the posterior circumflex artery also sends branches into the ligamentum teres.

6. These studies failed to demonstrate vessels entering the substance of the head by way of the ligamentum teres in specimens from infants and children under ten years of age. It was this observation which prompted the present study.

The author reviews the literature, which shows the controversy which has existed as to the importance of the various sources of arterial blood supply. While some authorities attach greatest importance to the vessels running through the ligamentum teres, others consider the vessels of the visceral capsule of the first significance.

The author's experiments with animals confirmed work reported by Cella which showed that in a developing animal the major proportion of nourishment to the growth center in the head of the femur is supplied by the capsular vessels. A number of human specimens of varying ages were also successfully injected (photographs of the injected specimens are included), as the result of which the following conclusions were reached:

1. The ossifying center in the developing head of the femur in infants and children receives its blood supply from the visceral capsule vessels which arise from the median circumflex artery.

2. The ligamentum teres vessels do not enter the head of the femur in children nor do they contribute to the nourishment of the growing femoral head except for very small vessels which accompany the fibrous tissue at the implantation of the ligamentum teres into the fovea area.

3. The anastomosis between the ligamentum teres vessels, the capsular arteries, and the nutrient artery of the shaft does not take place until the ossification of the head of the femur is practically, if not entirely, complete, at which time the vessels of the three systems unite by penetrating the thinned-out cartilage area at the fovea, thus establishing the anastomosis.

4. The ligamentum teres circulation is a closed circulation, in so far as the femoral head is concerned, until such an anastomosis takes place.

ELLIS C. OSGOOD, M.D.

Delayed Ossification of the Temporal Bone. Hans Brunner and H. James Hara. Ann. Otol., Rhin. & Laryng. **52:** 444–459, June 1943.

A five-month-old child had an acute otitis media and a right postauricular swelling. A right antrotomy was performed, and six days later the patient was admitted to the hospital with acute suppurative meningitis, which proved fatal.

The autopsy findings are presented in great detail. Chief features of interest were (1) the presence of areas of atypical epithelium in the membranous inner ear, indicating a developmental disturbance; (2) changes in the bony capsule of the inner ear and the ossicles; (3) meningitis invading the inner ear along the auditory meatus and the cochlear aqueduct.

The bony abnormalities were most pronounced in the periosteal layer, the greater portion of which consisted of a large marrow space containing hyperemic capillaries and lymphoid marrow. In the region of the cochlea the marrow space was separated toward the endochondral layer as well as toward the dura by a relatively thin layer of periosteal bone. Neither osteogenesis nor osteoclasis was observed along the margin of the marrow space. Within the marrow were a few spicules of bone, but these did not form a network, and some of them contained a core of calcified connective tissue—a picture usually seen in younger infants (two or three months).

Most striking were the findings in the area of the semicircular canals. Though normally in a child of five months the area between the canals is largely filled with periosteal bone, it was occupied here by lymphoid marrow. The periosteal marrow contained osteoblasts only occasionally, osteoid substance rarely, and osteoclasts never. This also is in contrast to the periosteal layer in a normal child of the same age, in which the small marrow spaces contain not only connective tissue and capillaries, but also osteoblasts, osteoid substance, and occasional osteoclasts.

There was evidence of delayed osseous formation, also, in the endochondral capsule, though to a less degree.

The authors believe that these bony abnormalities represent not a simple variation of ossification, but rather a retardation due to a pathological condition. The delay in bony development exceeded physiological limits and the process of ossification was irregular and incomplete, failing to follow the normal pattern. The destruction of cartilage prevailed over the formation of bony spicules engulfing the cartilage in the center of the marrow space. The picture was characteristic of osteogenesis imperfecta congenita, but obvious alterations in the rest of the skeleton, invariably described in reports of that disease, were not present. Whether the findings represented the earliest signs of an osteogenesis imperfecta tarda, or osteopsathyrosis, cannot be definitely stated. There was no history of blue sclera, brittle bones, or otosclerosis either in the patient or the family, and whether these might eventually have developed cannot be predicted in the absence of complete examination of the skeleton.

STEPHEN N. TAGER, M.D.

Etiology of the Undescended Scapula and Related Syndromes. D. Engel. J. Bone & Joint Surg. **25:** 613–625, July 1943.

This presentation is an attempt to define the cause of undescended scapula and to unite several other condi-

tions under the same causative agent. This single causative agent is believed to be a "bleb," and the theory is known as the "bleb theory."

This theory is outlined as follows: There is an area membranacea at the roof of the fourth ventricle through which cerebrospinal fluid escapes to form the subarachnoid space. If for some reason the area membranacea remains unduly patent, cerebrospinal fluid escapes into the subcutis of the adjacent neck region. This subcutaneous bleb causes failure of descent of the scapula because of the inflammatory reaction it initiates.

Experimentally, manifold deformities have been caused by bleb formation in animals. These blebs were produced by irradiation of the mother's ovaries, and the same deformities were passed on to subsequent generations of animals. The damage done by the bleb depends upon the time in the life of the embryo that it appears and its progression.

That the undescended scapula is due to bleb formation is seen from the fact that it is one of the signs of dysostosis multiplex, which belongs to the bleb disease group. If the bleb originating in the neck descends anteriorly, it exerts its greatest pressure at the end of the limb bud, resulting in the deformity known as symbrachydactylia. If the bleb remains on the posterior neck surface and fails to migrate, the Klippel-Feil syndrome develops. If the bleb progresses distally, somewhat, the undescended scapula deformity results.

JOHN B. MCANENY, M.D.

Congenital Retardation in Development of the Carpal Navicular, First Metacarpal, and Styloid Process of the Radius. A. R. Hodgson. Brit. J. Surg. **31:** 95–96, July 1943.

A female, aged 29 years, had always suffered from weakness of the wrists, especially the left. Examination revealed atrophy of the left thumb, hand, wrist, and distal part of the forearm. The thumb was adducted along the index finger; full abduction was about 20 degrees from the long axis of the ulna. The scaphoid could not be felt on palpation with the hand in full ulnar deviation. The power of grip was one-eighth of normal.

Roentgenograms showed a tiny rudimentary navicular measuring 0.5 cm. by 0.25 cm. The distal end of the bone had a fairly round clear-cut edge and the proximal end had an indistinct margin. There were complete absence of the styloid and some shortening compared with the ulna at the radio-ulnar joint. The proximal end of the first metacarpal had no tubercle for the insertion of the abductor pollicis longus.

In the right hand these same deformities were present, but in less degree.

MAX CLIMAN, M.D.

Osteogenesis Imperfecta. James F. Brailsford. Brit. J. Radiol. **16:** 129–136, May 1943.

Osteogenesis imperfecta is believed to be a severe form of the dystrophy variously called idiopathic osteopsathyrosis, fragilitas ossium, and hereditary fragility of bone. These designations should be dropped and the term osteogenesis imperfecta be extended to include the fetal, infantile, adolescent, and adult types of the disorder.

This dystrophy has a familial distribution, and the affected members usually show, in addition to the bone changes, blue sclerotics. Deafness is sometimes associated.

In the fetal form the bones have a thin cortex. The internal structure is granular, indicating a calcification rather than ossification. The infantile type is frequently characterized by small, multiple, rounded, bony, cell-like structures, enclosing non-osseous tissue, particularly in the epiphyses. These are similar to the rounded cartilaginous structures seen in ecchondroses. In the adult and adolescent types the long bones have slender shafts composed almost entirely of compact bone while the expanded extremities are of coarse cancellous tissue; deformities of the ribs and pelvis are common.

The skull exhibits a considerable variation in the degree of involvement. In infancy it usually appears thin and ballooned. As the child grows it seems to settle down over the base, producing a tam-o'shanter appearance. The vertebral bodies show more or less compression. Fractures are common.

Nine cases are presented in detail.

SYDNEY J. HAWLEY, M.D.

Osteopathia Condensans Disseminata Associated with Coarctation of the Aorta: Case Report. George S. Phalen and Ralph K. Ghormley. J. Bone & Joint Surg. **25:** 693–700, July 1943.

This is a case report of a patient who had twisted her left ankle. Roentgenograms showed sclerosis of all the bones of this region. Further roentgen study revealed osteopetrosis of the entire left lower extremity and the right humerus. Other bones showed small areas of bone condensation which were believed to represent osteopoikilosis. An associated coarctation of the aorta was indicated by notching in the lower rib margins.

JOHN B. MCANENY, M.D.

Gargoylism: Report of Three Probable Cases. Sidney Larson and John A. Lichty, Jr. Am. J. Roentgenol. **50:** 61–66, July 1943.

In gargoylism the head is usually large and the neck short. The nasal bridge is flat and broad. The lips may be thick and the tongue protruding. Dentition may be delayed. There may be, also, mental retardation, corneal clouding, and enlargement of the liver and spleen. The abdomen is protuberant. The legs and arms are relatively short, the joints held in semiflexion; the hands are short and broad, and there is a lumbodorsal kyphosis. Other clinical features are mucopurulent rhinorrhea, recurrent otorrhea, deafness, poorly developed muscles, hypertrichosis, retarded sexual development, and leathery skin. Morquio's disease offers the greatest problem in differential diagnosis, but mental retardation is not present in that condition, the skull shows no abnormalities, and the vertebral deformity is not the same.

Abnormal findings in the skull are a constant feature of gargoylism. The cranium is enlarged and frequently there is hydrocephalus. Abnormal shapes are common. Sellar changes are not constant. The ribs may be markedly broadened and the scapulae are often high in position. The spine is involved in a peculiar kyphosis of the dorsolumbar region. This kyphosis is the most constant osseous change. The bones of the extremities are thickened. The humeral and femoral heads may be irregular and flattened. Retarded carpal ossification is not uncommon.

The term "gargoylism" is noncommittal in etiological implication. The term "lipochondrodystrophy"

suggests the association of the disease with the lipoidoses. Washington (in Practice of Pediatrics, edited by J. Brenneman, Hagerstown, Md., W. E. Prior Co., Vol. IV, Chapter XXX) studied 6 cases postmortem. The salient histologic feature in these cases was the degenerative change in the nerve cells of the central nervous system. The cytoplasmic lipoid deposits found were most pronounced in the basal ganglia and the brain stem. Lipoid infiltration has been identified in liver, spleen, lymph nodes, lungs, heart, and thymus, but not in the bones.

The authors describe in detail three cases exhibiting some of the features characteristic of this disease.

CLARENCE E. WEAVER, M.D.

Osteochondritis Dissecans. Records of Some Unusual Cases. Robert G. Hutchison. Brit. J. Radiol. **16:** 147–149, May 1943.

By way of emphasizing the occurrence of osteochondritis dissecans in sites other than the typical one in the knee, 7 cases are put on record, 3 involving atypical sites in the knee, 2 involving the ankle, 1 the phalanx of a toe, and 1 the head of a metacarpal bone.

Multiple Spontaneous Idiopathic Symmetrical Fractures: Milkman's Syndrome. Louis Edeiken and Norman G. Schneeberg. J. A. M. A. **122:** 865–870, July 24, 1943.

Milkman's syndrome is a very rare skeletal osteopathy appearing mainly in middle-aged women and consisting of multiple spontaneous idiopathic pseudofractures. A review of the 19 other cases reported in the medical literature, in addition to information gleaned from their own patient, leads the authors to conclude that, although the clinical picture of this abnormality almost invariably conforms to a readily recognizable pattern, final diagnosis must necessarily be made by the roentgenologist.

The outstanding roentgenographic features are fairly symmetrical focal osteoporotic areas which progress to form translucent bands of intense local decalcification. These spread in a transverse fashion until eventually a complete transverse solution of bone continuity resembling a fracture may be produced. Early no deformity is present, but later, separation, displacement, and overriding of fragments may occur. Settling of the vertebral column, formation of a heart-shaped pelvis, coxa vara, rib, ulnar, and clavicular angulation may also appear in time. Ordinarily there is no callus formation.

Treatment of this condition has not been entirely satisfactory. Several reported cures have resulted from treatment with calcium, vitamin D, arsenicals, and vitamin A.

DEPARTMENT OF ROENTGENOLOGY
UNIVERSITY OF MICHIGAN (J. H.)

Paralytic Scoliosis. Aladár Farkas. J. Bone & Joint Surg. **25:** 581–612, July 1943.

This is an extensive study of the spinal curvature developing after infantile paralysis. Within a few weeks or months following the onset of paralysis a definite entity, known as the paralytic spine, is recognized from morphological and functional signs. The morphological signs are enlargement of the intervertebral spaces, which become dull and cloudy; early and irregular ossification of the epiphyseal ring; calcium deposits in the intervertebral spaces. General bone atrophy may last for several years and heal spontaneously. The functional signs include a high degree of flexibility and compressibility. Univertebral or segmental rotation, without lateral deviation, occurs early. Forward or backward tilting may take place, with loss of the normal lordosis and kyphosis.

The paralytic spine precedes paralytic scoliosis by several years, during which interval the convexity and direction of the rotation may change several times.

Rotation results from faulty mechanics of (1) the pelvis, (2) the thorax and shoulder girdle, and (3) respiration. In pelvic rotation all the spinous processes point to the same side of the body. In thoracic rotation the thoracic and lumbar spinous processes point in opposite directions.

The various curvatures are demonstrated by numerous reproductions of roentgenograms.

JOHN B. MCANENY, M.D.

Differential Diagnosis of Spinal Arthritis in Young Subjects. C. W. Buckley. Brit. M. J. **2:** 4–6, July 3, 1943.

The author points out the difficulty of the diagnostic problem of spinal arthritis in young people and emphasizes the importance of this condition due to rapid progress in the more serious form.

The typical disease known as adolescent spondylitis first manifests itself by vague back pains, pains in the limbs, and eventual flattening of the lumbar curve. This is followed by synovitis, hyperemia of the apophyseal joints of the lumbar spine and the sacroiliac joints, and thereafter similar involvement of all joints concentrically. Spinal disks do not become thin but may even expand, and complete ankylosis is the eventual result from surrounding calcification. The smaller joints may be spared. One distinguishing characteristic lies in the response to gold therapy. The latter seems to have a valuable effect in the form of arthritis which attacks older people but is of no help in adolescents.

Considerable emphasis is placed on the adolescent sacroiliac joint syndrome. A large percentage of victims are tuberculin-sensitive. It is pointed out that x-ray examinations should be made in a three-quarter lateral position in order to show the apophyseal joints. A loss of density in the articular processes, with a blurring of the joint outlines is among the earliest roentgen signs. The treatment consists mainly of rest, diet, and heliotherapy.

Q. B. CORAY, M.D.

Ankylosing Spondylarthritis: Marie-Strümpell Arthritis. Roentgen and Orthopedic Therapy. Lenox D. Baker. Southern M. J. **36:** 180–184, March 1943.

Rhizomelic spondylosis, Marie-Strümpell arthritis, or von Bechterew's disease is a malady of the spine and root joints of unknown etiology. Early diagnosis of this condition is occasionally overlooked by qualified roentgenologists. Decalcification and mottled trabeculation can usually be demonstrated in the subchondral regions of the sacroiliac joints, with haziness and apparent widening of the joint spaces. Associated with these changes are focal areas of increased density. These findings may be unilateral or bilateral and are usually present before the spinal lesions become evident. Later there is a sclerosis of the subchondral area with destruction of the articular cartilage and osseous bridging of the joint space. Ankylosing ossifications

in this condition, so-called "syndesmophytes," should be differentiated from the non-ankylosing osteophytes. The former appear at first as wooly shadows which later become dense, linear, and clear cut, without a cortex. The osteophyte has a thicker base, is covered with a cortex, and contains cancellous bone.

The author cites Swaim's report (J. Bone & Joint Surg. **21:** 983, 1939) on the orthopedic treatment of the disease and that of Smyth, Freyberg, and Lampe (J. A. M. A. **117:** 826, 1941) on roentgen therapy of rheumatoid arthritis of the spine. He then proceeds to a description of the régime used in his institution (Duke University), which combines orthopedic and roentgen treatment. Roentgen therapy is given over the entire spine or the involved area, depending on the clinical findings. Two hundred kilovolts are used in treating fields about 5 × 15 cm., 150 r being given over one or more areas daily for three to five treatments. If necessary, the dosage is repeated after three to six weeks. Roentgen-ray therapy gives early alleviation of pain with relief of muscle spasm and allows rapid correction of deformities and more vigorous attempts at restoration of muscle balance. The orthopedic measures include hyperextension of the spine, traction when this is necessary to correct flexion deformities of the hips, corrective exercises, and application of a specially designed brace, which is described and illustrated.

Satisfactory correction of deformities in the Marie-Strümpell group of patients frequently requires many weeks of hospitalization with the patient recumbent on a Bradford frame. Since the introduction of roentgen therapy the average time for correction with the combined therapies has been reduced to ten days and hospital stay to two weeks, though a longer period of hospitalization may be advisable for continued physical therapy and further supervised muscle training.

Too short a time has elapsed to determine whether the roentgen therapy is only analgesic or whether it has a deterrent effect on the disease and serves to prevent further ossification of the ligamentous structures of the spine. The fact that it has been followed by a reduction in sedimentation rate is a hopeful sign.

MAX MASS, M.D.

Herniation of the Nucleus Pulposus as a Complication of Pre-Existing Low Back Instability. Edwin M. Deery. Surg., Gynec. & Obst. **77:** 79–86 July 1943.

The author classifies cases of herniated nucleus pulposus into two groups. The first is characterized by sciatic pain with a minimum of low back discomfort and no preceding history of "back trouble." It is in these patients that removal of the herniated nucleus alone is required. In the second group of cases herniation of the nucleus is superimposed on low back instability and in these cases fusion may be necessary.

In the author's experience a careful neurologic examination will in most instances accurately indicate the presence of a herniated nucleus as well as its level, without recourse to lipiodol.

A distinction is drawn between sciatic pain, about which the patient complains, and sciatic neuritis, a condition which produces objective neurologic changes, such as absence of the ankle jerk.

The diagnosis of herniated nucleus is made on the basis of a history of sciatic pain, with or without low back pain. There may be a limp, a loss of the normal lumbar lordosis, and postural deformities of the lumbar spine. The neurologic signs are definite and consist of weakness of dorsiflexion of the foot, muscle atrophy and reduced or absent ankle jerk, and sensory changes along the outer side of the lower leg and foot. The author does not believe that the overlapping of the sensory distribution in the lower leg negates the clinical experiences which show a correlation between the distribution of the neurologic changes and the location of the herniation. If the sensory changes are limited to the outer side of the lower leg and ankle and foot, the herniated nucleus will generally be found in the lumbosacral interspace. If, in addition, there are sensory losses on the inner side of the foot from toe to heel the nucleus will be found in the 4th–5th lumbar interspace. Straight leg raising is limited on the painful side. The author attaches little importance to the x-ray survey of the lumbosacral region. Lumbar puncture is advocated to rule out spinal cord tumor, as well as to assist with the diagnosis of herniated nucleus, in which condition there are usually normal manometric findings but an elevation of the spinal fluid protein.

The author, as mentioned above, does not advise the use of lipiodol. He has not found it necessary and believes it may be harmful if left in the spinal canal. Its removal is often so incomplete as to be unreliable. Air myelography is considered unsatisfactory.

In the author's clinic operations for nucleus pulposus and fusion operations for an unstable back are carried out at the same time. The mortality in 100 cases was zero. The offending herniation is exposed and removed through the interlaminal space with sacrifice of little or no bone.

Herniated nuclei are of three types, Type I is the small, round, oval mass covered by the overlying lateral portion of the posterior longitudinal ligament. The mass has a rubbery resistance and is overlaid by the spinal dura and the involved nerve root. The author advocates retracting the nerve root medially, which exposes the lesion well, after which it may be removed with clamps, forceps, or curette. Type II is less common. It is a type in which the nucleus has already forced its way partly or wholly through the posterior longitudinal ligament. It lies directly under the nerve root almost free within the spinal canal. This type is readily picked up and removed in one piece. Type III is the least common. This small, almost flat lesion is often missed and by some is considered not a herniation at all. The author, however, believes that removal is indicated in such cases. Following removal of the herniated nucleus, any thickened ligamentum flavum tissue which is present should be curetted out in order to make sure that the intervertebral foramen is not obstructed.

The author does not consider sciatic pain alone convincing proof of the presence of a herniated nucleus; it may be due to a low back instability which is readily relieved by orthopedic measures. Symptoms due to herniated nucleus are not relieved by fusion operation alone in his experience, and certainly not by fasciotomy.

ELLIS C. OSGOOD, M.D.

Posterior Hernia of the Knee (Baker's Cyst, Popliteal Cyst, Semimembranosus Bursitis, Medial Gastrocnemius Bursitis and Popliteal Bursitis). Henry W. Meyerding and Robert E. VanDemark. J. A. M. A. **122:** 858–861, July 24, 1943.

Baker's cyst is a popliteal cyst which occurs as the result of (1) herniation of the synovial membrane

through the posterior part of the capsule or (2) the escape of fluid through the normal anatomic connections of the knee joint into the bursae. Basing their article on a series of 15 cases, the authors discuss the etiological factors predisposing to the development of these lesions, their preoperative diagnosis, and the surgical treatment which offers the best prognosis.

Patients with Baker's cyst, which incidentally is almost always unilateral, generally complain of aching and stiffness of the knee and a tumor, the bulk of which is usually distal to the flexion crease of the knee. Transillumination reveals the uniform cystic character of the lesion and aspiration demonstrates the fluid contents.

Connection of the cyst with the joint can be demonstrated roentgenographically. After injection of 100 to 150 c.c. of air into the knee, the roentgenogram will often reveal an air bubble in the hernial sac. This procedure is not recommended as a routine measure because of the potential dangers of pulmonary embolism and sepsis.

Baker's cyst is to be differentiated from lipoma, fibrosarcoma, hemangioma, aneurysm, arteriovenous fistula, pyogenic or tuberculous abscess, popliteal lymphadenopathy, Charcot's joint, and varicose veins.

DEPARTMENT OF ROENTGENOLOGY
UNIVERSITY OF MICHIGAN (J. H.)

Fractures of the Neck of the Metacarpal. Irving Redler. J. Bone & Joint Surg. **25:** 670–674, July 1943.

Permanent deformity and disability frequently follow treatment of fractures of the neck of the metacarpal by traction methods. The author reports good results in 22 cases with the method of Jahss.

The procedure consists in breaking up the impaction, by direct manipulation, and traction correction of overriding. A plaster cast is applied to the forearm, wrist, and hand as far as the fracture site, with the wrist in slight extension. When the plaster is thoroughly set, the injured finger is flexed to 90 degrees at the metacarpophalangeal joint and proximal interphalangeal joint, with the distal interphalangeal joint remaining in extension. In this position the finger points toward the scaphoid tubercle. The injured finger is fixed in this position by a thin strip of plaster and incorporated in the cast, being pressed dorsally to correct the deformity and held in this position until the plaster sets. Immobilization is maintained for three weeks. After removal of the cast, joint motion returns very quickly, as a rule. JOHN B. MCANENY, M.D.

Pin Distraction as the Cause of Non-Union. Arthur G. Davis. J. Bone & Joint Surg. **25:** 631–643, July 1943.

The occurrence of 6 cases of non-union of the lower tibia within a period of nine months focused the author's attention on this problem. All cases had been treated by pin distraction, with failure of callus formation and union to occur within a reasonable period of time. Serial roentgenograms demonstrated the nonunion and distraction.

All 6 cases were subjected to bone-grafting procedures, with firm union taking place in from three to six months, showing that the potentiality for callus formation was present but that it was hindered from coming into action. Distraction is believed to be the cause in each case.

Many writers have advised caution in the use of mechanical methods to obtain reduction in fractures where one or both fragments is pulled by means of pins in the bone. It is believed that no reasonable manual or weighted pull on a fragment is capable of tearing the periosteum completely at the fracture site, but that with the pin traction sufficient force can be applied to produce a complete tear of the periosteum around the circumference of the bone.

This word of caution as to distraction of fractures as a potent cause of non-union should be seriously considered by both radiologists and surgeons.

JOHN B. MCANENY, M.D.

Plasmocytosis of the Bone-Marrow Associated with Metastatic Carcinomatosis. E. Miller. South African M. J. **17:** 61–63, Feb. 27, 1943.

A case of plasmocytosis of the bone marrow associated with metastatic carcinomatosis of bone is described in detail. The patient, aged 56 years, had painful swellings of the skull and sternum, which had been present for three months and had been gradually increasing in size. He also complained of loss of weight, anorexia, and malaise. The larger skull tumor, measuring about 3 inches in diameter, was fairly hard in consistency, although small areas were soft and fluctuating. The tumor was attached to the bone, but not to the skin; it was not warm to the touch. Just anterior to it was a similar tumor. A third tumor, about 1.5 inches in diameter, was attached to the body of the sternum at the level of the fifth costal cartilage. No other significant findings were noted on physical examination.

An x-ray study of the skull showed multiple large and small areas of erosion in the vault. Filling the largest gap in the vault and extruding from it was a tumor. Small particles of bone could be seen in this tumor, probably fragments of skull.

A blood count showed hemoglobin 30 per cent; red blood cells 2,000,000; white blood cells 15,000, with a high proportion of polymorphonuclear cells. No immature cells of the granular series, normoblasts, or plasma cells were seen. Examination of the bone marrow revealed a high proportion (6.5 per cent) of cells of the plasmocyte series.

Permission to perform a complete necropsy could not be obtained, but small sections of the skull and sternal tumors removed for examination showed adenocarcinoma, which was believed to be of prostatic origin.

Notes on the literature regarding the plasma cell are given.

Solitary Eosinophilic Granuloma: Report of a Case. Graham A. Kernwein and Frank B. Queen. Surgery **14:** 105–110, July 1943.

Solitary eosinophilic granuloma is an uncommon benign destructive bone lesion of which, according to the authors, only 19 cases have appeared in the medical literature. Although the microscopic pathologic picture is characteristic, the pathogenesis has not been established. [The authors are not in agreement with certain observers (see for example, Gross and Jacox: Am. J. M. Sc. **203:** 673, 1942. Abst. in Radiology **40:** 215, 1943) that the condition is identical with Schüller-Christian disease.]

In the case here recorded the patient, a white male, 20 years of age, complained of increasingly severe pain in his right groin. Roentgen studies of the pelvis and

left hip showed an irregular region of decreased density at the upper end of the femur, mesial and inferior to the lesser trochanter. Films of the leg in internal rotation showed a thin strip of periosteal new bone. No lesions were found in the chest or in the remainder of the skeleton. A biopsy specimen was removed from the femur and a diagnosis of solitary eosinophilic granuloma was made. One week later the wound was reopened and marrow from the upper third of the femur was removed. The postoperative course was uneventful, and twenty-eight months later the patient was well and the operative defect was largely replaced with new bone.

Filling the marrow cavity in this case was a compact fibrous type of granulation tissue containing isolated, well encapsulated granulomas. Numerous eosinophilic polymorphonuclear leukocytes arranged in sheets and cords with very little supporting stroma were the most conspicuous feature of these granulomas. Interspersed throughout were numerous large polygonal cells with abundant pale cytoplasm and poorly outlined cell membrane. They contained large oval or kidney-shaped nuclei with occasional mitotic figures. In older lesions many of these cells had fused to form multinucleated giant cells. Phagocytized eosinophilic leukocytes were present in some; in others the cytoplasm appeared vacuolated. Although most of the bony trabeculae had been destroyed, some newly formed bone was present on the surface of the few remaining spicules. There were no areas of necrosis.

J. E. WHITELEATHER, M.D.

GYNECOLOGY AND OBSTETRICS

Combined X-Ray and External Pelvimetry. Daniel J. McSweeney and Albert M. Moloney. Am. J. Obst. & Gynec. **46:** 102–109, July 1943.

X-ray pelvimetry should supplement and not supplant external pelvimetry and clinical examination of the pelvis. The authors' method of investigation for cephalopelvic disproportion, preferably done within two weeks of the expected date of confinement, or better at the onset of labor, consists of (1) external pelvimetry, (2) estimation of fetal head size, and (3) x-ray pelvimetry if indicated.

The following criteria determine the need for x-ray pelvimetry:

1. Floating heads at term, in primiparas.
2. History of previous difficult deliveries.
3. Breech presentations in primiparas with apparently small pelves by external measurements.
4. Narrow subpubic arches and outlets.
5. External conjugates of 18.5 cm. or less, in elderly primiparas.

The technic is described as follows: "We take a film directly through the pelvic inlet with the patient semirecumbent to get a good view of the contour of the inlet. The inlet is then classified according to the classification of Caldwell and Moloy. A true lateral film is then taken on which we measure the conjugate vera, the anterior sagittal, posterior sagittal, and anteroposterior diameters of the midpelvis, the pubotuberous diameter, and biparietal diameter of the fetal head if possible. The correction factor for object-table top distance for all these latter measurements which are in the same sagittal plane is one-half the intertrochanteric diameter which we have already taken by external pelvimetry. To this measurement the table top-film distance is added to obtain the object-film distance. The mathematics is completed by the Ball calculator, by the Snow and Lewis slide rule, or by the simple mathematical formula $O = I \frac{D - d}{D}$, in which O is the object, I the magnified image as measured on the film, D the target-film distance, and d the object-film distance."

Assuming the fetal head to be average in size, the question of probable dystocia at the various planes can be reduced to the following simple observations:

Dystocia at Inlet: A conjugate vera under 10 cm. in generally contracted pelvis or under 9.5 cm. in flat pelvis is significant. The contour of the pelvis, such as the angulation of the fore-pelvis and a flattened posterior pelvis, must be considered.

Dystocia at Mid-pelvis: A posterior sagittal under 3.5 cm. and a subpubic arch under 5.5 cm. suggest trouble. X-ray examination is indicated to note any convergence of the sacrum and pubis and to determine whether the sacrococcygeal junction is angulated in a manner to interfere with the descent of the head.

Dystocia at Outlet: An interpubic measurement under 5.5 cm., an intertuberous under 9.0 cm., or a pubotuberous under 11 cm. presages difficulty. A narrow arch will necessitate a lower descent of the head to find an adequate diameter for occipital impingement.

The more conservative management of so-called borderline cases made possible by the methods described has resulted, in the Boston City Hospital, in a decrease of 50 per cent in the number of sections done for cephalopelvic disproportion. Of 300 women in the borderline group, 250, or 83 per cent, were delivered easily, either normally or by low forceps. Three fetal deaths and no maternal deaths were noted in the entire series of 300 cases. STEPHEN N. TAGER, M.D.

Relation of the Sacral Promontory to the Pelvic Inlet. Herbert Thoms. Am. J. Obst. and Gynec. **46:** 110–116, July 1943.

With the exception of the skull, no portion of the skeleton presents greater individual variations than the pelvis. Apparently this is to be accounted for by its development from a number of bones and the nutritional, mechanical, and hormonal influences to which it is subjected during its growth.

The present study is concerned with one aspect of pelvic variation, the relationships of the upper sacrum, particularly the position of the sacral promontory in relation to the plane of the pelvic inlet.

The roentgenologic findings in 200 women all in their first pregnancy, were studied. It was found that a wide variation exists in the position of the promontory in its relation to the posterior end-point of the antero-posterior diameter of the plane of the pelvic inlet. From a study of the figures given, it is apparent that the position of the forward edge of the sacral promontory is too unreliable to be considered as the posterior end of the true conjugate diameter. In this series, it was at or close to this point in but 30.5 per cent of the cases. Because of this positional variation, the value of the diagonal conjugate diameter as an index of the true conjugate is also questionable. Indeed, two cases are cited with identical conjugate diameters of *13.0 cm.* and *true conjugates of 11.9* and *10.5 cm.*, respectively. The estimation of the true conjugate diameter based on the length of the diagonal conjugate was approximately correct in only 38 per cent of the cases in this series.

An analysis of the relationship of high promontory positions and various types of pelvis failed to produce any definite conclusions, though a high promontory was "somewhat, if but slightly, associated with dolichopellic and mesatipellic types of pelvis."

Except in those instances where the promontory is at or near the posterior limits of the plane of the pelvic inlet, it is difficult to see how in high positions it can play a very major part in the mechanism by which the fetal head settles into the pelvis.

This study emphasizes again that roentgenologic methods are an important adjunct to the usual diagnostic obstetric procedures. STEPHEN N. TAGER, M.D.

GENERAL CONSIDERATIONS

Significance of a Close Co-operation between the Roentgenologist and the Internist. Herbert Ludwig. Schweiz. med. Wchnschr. **73:** 898–900, July 17, 1943.

Roentgenologic science has developed to an extent that prevents the average internist from having any clear knowledge of technic and its effect on the findings. Too often this results in a failure to integrate the roentgen findings, which are after all only a description of departures from the normal average, into the clinical picture. A close co-operation, with control of results by operation or necropsy, is essential.

By way of illustration, the difficulties in the diagnosis of duodenal ulcer are considered. Only in the absolutely characteristic case can the diagnosis be made clinically. On the other hand, there are also rare cases in which a roentgen study shows an apparently normal cap. Cases of Lamblia infestation of the duodenum may give a clinical picture of ulcer; differentiation may be made by a microscopic study of freshly aspirated duodenal contents. In symptomatically atypical cases a careful roentgen study, with special attention to mucosal study of the cap and oblique views, will be needed to clarify the diagnosis.

Three diagnostic problems in which the employment of careful roentgen study led to a correct interpretation of unusual findings are very briefly reported; the final diagnoses in these were subphrenic abscess, bronchial carcinoma, and pulmonary tuberculosis.

LEWIS G. JACOBS, M.D.

RADIOTHERAPY

NEOPLASMS

Primary Carcinoma of the Eustachian Tube: A Study of the Evidence of Its Occurrence. Lawrence J. Lawson. Ann. Otol., Rhin. & Laryng. **52:** 377–390, June 1943.

The importance of searching the nasopharyngeal approach to the ear in the presence of persistent eustachian tube obstruction or unexplained cervical metastases is emphasized. The alert examiner will recognize and make a biopsy of the first tumor bulge associated with persistent tubal closure, especially one which prevents inflation.

It seems highly probable that a fair proportion of lateral nasopharyngeal tumors originate in the eustachian tube. Yet, judging from the published reports, primary carcinoma of the tube is rarely demonstrated. The author quotes a number of cases from the literature and records one of his own. His patient was a man of 59, who came for examination because of slight bleeding from the throat. He complained also of deafness in the right ear, tinnitus, and partial blockage of the right nostril. Examination of the nasopharynx revealed a mass apparently originating in, or in the area of, the right eustachian tube, partly obstructing the right nostril. The tube had been blocked for many months and a consulting otologist had been unable to inflate the right ear. Biopsy revealed transitional-cell carcinoma. No enlarged cervical nodes were observed. Intensive x-ray treatment was given over the tumor: 10,000 r through two ports (5,150 r to the lateral right nasopharynx and 4,450 r to the anterior right malar region). Three upper teeth were removed to facilitate the treatment. The factors were: 400 kv., 3 mm. copper filtration, 75 and 80 cm. distance. Following treatment there was considerable regression of the tumor. Six 2-millicurie radon seeds were implanted in the residual mass, and nine months after its discovery the tumor had disappeared and there was no evidence of extension.

On the basis of his collected series of 14 cases, the author goes on to a discussion of the clinical and pathological features of eustachian tube tumors. It is apparent in most instances that the neoplasm arises from the cartilaginous portion of the tube. Extension to the sphenoidal fissure and orbit may result in an ocular syndrome. There was only one instance of distant metastasis in this group of cases. The pathological diagnosis differs, but Salinger and Pearlman (Arch Otolaryngol. **23:** 149, 1936. Abst. in Radiology **27:** 255, 1936) believe that most of the tumors are transitional-cell carcinomas or lymphoepitheliomas.

In 9 cases of the series there was early evidence of eustachian tube involvement. A firm mobile tumor at the level of the tubular eminence was detected in 7 cases, usually with inward or forward bulging of the pharyngeal wall at this level. Ulceration was not a prominent feature. Salpingoscopy gave evidence of complete obstruction in 6 instances.

The most favorable treatment would appear to be deep x-ray therapy combined with radium or radon. Whether x-ray or radium element is employed, the underlying principles outlined by Coutard should be given proper consideration. One method suggested is to expose the primary lesion and the lymphatic region, if this is involved, daily or twice daily to x-ray or radium for twenty to sixty days. Adequate filtration is used to obtain the most highly penetrating rays. When the primary lesion is small and localized, surface applications of radium or radium and radon may be combined with external x-ray therapy. There is, however, a tendency to regional invasion, particularly into the skull, even though the nasopharyngeal mass may seem to have regressed. STEPHEN N. TAGER, M.D.

Radiation Therapy in Cancer of the Esophagus: Analysis of 85 Cases Observed during the Last Decade. Ernst A. Pohle and Roland R. Benson. Am. J. Roentgenol. **50:** 89–97, July 1943.

In all cases of esophageal cancer where palliative irradiation is indicated the authors believe that roentgen rays should be given preference. They are safer than intra-esophageal radium therapy. In the upper

third, two lateral fields and one anterior field are used; in the remaining parts of the esophagus an anterior and a posterior field or two oblique anterior fields suffice. The single daily dose per area does not exceed 150 to 200 r (in air), or the total dose 2,000 r per field in the upper esophagus and 1,200 to 1,600 r per area in the lower esophagus. The authors believe that the production of severe reactions is not justifiable in treatment for strictly palliative purposes. In the upper esophagus there is a greater chance of an occasional cure than in the lower esophagus, so that larger dosage in the upper area is justifiable. It is desirable to reach tumor doses of from 3,000 to 4,000 r. With a small number of fields, better control of the entering beams is assured, treatment can be given day after day with the same technic, and calculation of the dose effective in the tumor is more accurate. The size of the field depends on the extension of the growth, which is localized roentgenoscopically and carefully projected on the skin with indelible markings.

Radium in the form of screens or seeds may easily lead to a perforation. Even the introduction of radon seeds loaded into a stomach tube is better carried out after preliminary roentgen therapy, when the tumor has shrunk. Radium may be used along with or immediately at the end of the roentgen therapy or may be given three or four months later to destroy any residual tumor.

Eighty-five patients with cancer of the esophagus have been seen by the authors during the last thirteen years. Over 90 per cent were admitted with advanced lesions and in only a few did the general condition permit of a thorough trial of radiation therapy. The ratio of males to females was almost five to one. The middle third of the esophagus was involved most frequently. Squamous-cell carcinoma was found most often. The average duration of life after hospital admission was 6.7 months, but about 10 per cent of the patients lived longer.

The hopelessness of the prognosis lies chiefly in the fact that these patients are seen too late. Effort must be directed toward an education of both the general practitioner and the public in order to detect these lesions early. Improvement in technic of treatment is also desirable. It is hoped the higher tube voltage now available can improve the situation. One patient in the authors' series with cancer of the upper end of the esophagus treated by roentgen irradiation alone is alive and well for over four years, and another treated by roentgen irradiation and implantation of radon seeds is alive and well for over seven years. These survivals and the degree of palliation obtained in other cases are encouraging.

Illustrative case reports are given with details of treatment in lesions of the upper, middle, and lower portions of the esophagus.

CLARENCE E. WEAVER, M.D.

Carcinoma of the Cervix: A Study of 233 Cases Including 103 Five-Year Cases with a Survival Rate of 33.9 Per Cent. James R. Johnston. Pennsylvania M. J. **46:** 1062–1066, July 1943

A series of 233 cases of cancer of the cervix have been seen in the tumor clinic at the West Penn Hospital (Pittsburgh, Penna.) in the past ten years. Of these, 103 are five-year cases, the youngest patient being 22 years old and the oldest 84. Twenty-five per cent were under forty years of age. The symptoms varied, but irregular spotting of blood was the predominating sign. The diagnosis is made by careful inspection and palpation of the cervix and by biopsy.

Of the series of 233 cases, 36.5 per cent were in clinical stage I, 40.3 per cent in stage II, 13.7 per cent in stage III, and 9.4 per cent in stage IV. Epidermoid carcinoma was found in 80.2 per cent of the cases, adenocarcinoma in 9.4 per cent, and undifferentiated carcinoma in 10.3 per cent.

The author believes that giving x-ray first lessens the infection and shrinks the massive growth so that the application of radium is made much safer. The x-ray dosage varies with the tolerance of the patient; 1,600 to 2,200 r are given to each of four portals over a period of three weeks. Radium is given in doses of 3,600 to 4,800 mg. hr. In some cases radiation is applied interstitially, in the form of four or five 10-mg. needles inserted in the parametrium. Treatment is not repeated unless there is a recurrence proved by biopsy.

Uremia is a complication due to compression of the ureter as a result of parametrial extension. Relief may sometimes be obtained by using indwelling ureteral catheters. Vesicovaginal fistulas or rectovaginal fistulas occurred in 5 of the author's cases. Non-carcinomatous post-irradiation ulceration occurred in 4 cases.

It is important to re-examine all patients at intervals, as many examples of recurrence have been found, although the patient was symptom-free. The survival rate for the 103 five-year cases was 33.9 per cent.

JOSEPH T. DANZER, M.D.

Inadequate and Ill-Advised Surgery in the Treatment of Carcinoma of the Cervix. L. C. Scheffey and G. A. Hahn. Pennsylvania M. J. **46:** 1056–1061, July 1943.

The mortality and survival rates reported by a few surgeons who do hysterectomies for carcinoma of the cervix are reviewed by the authors, who compared these figures with series in which surgery was supplemented by irradiation and others in which treatment was by irradiation alone. They believe that in general the radical operation preceded by irradiation does not give as good results as irradiation without operation and characterize the simple type of hysterectomy as a hazardous and delaying measure.

JOSEPH T. DANZER, M.D.